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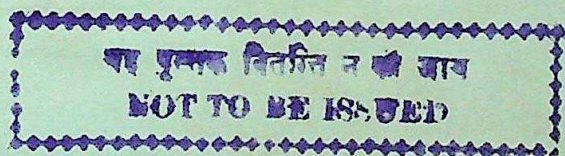
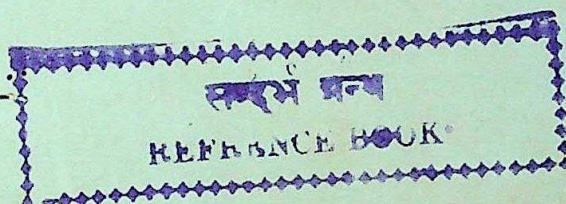
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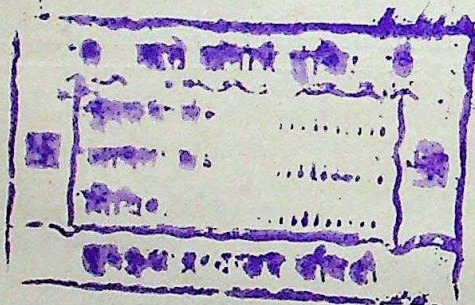
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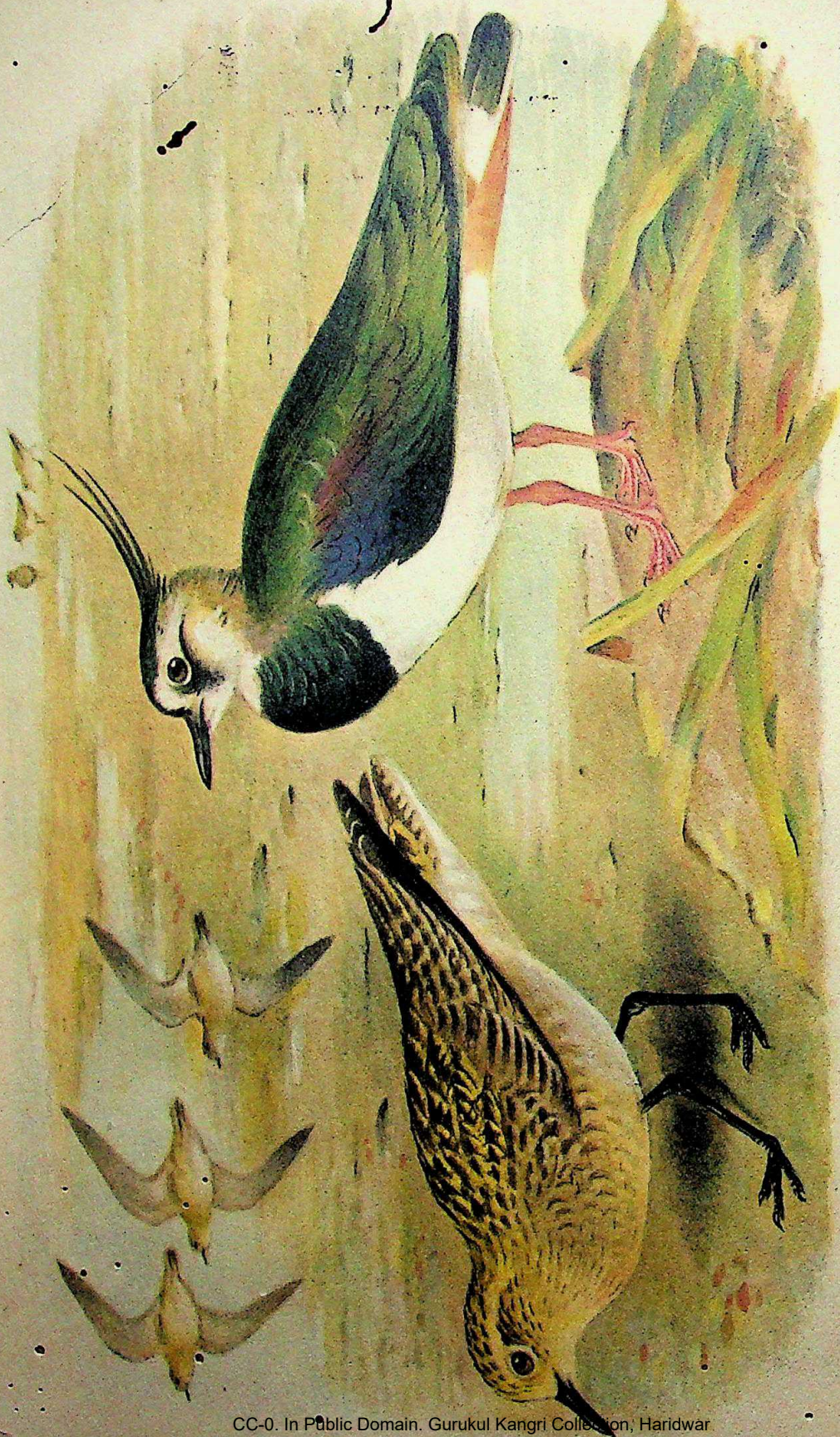
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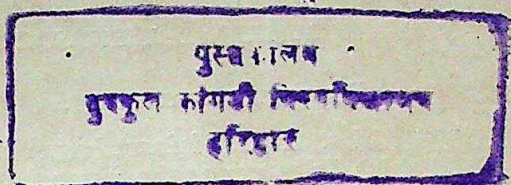
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THE LAPWING. $\frac{2}{5}$.
Vanellus vanellus.

THE EASTERN GOLDEN PLOVER. $\frac{2}{5}$.
Pluvialis dominicus fulvus.





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No. 1

THE GAME BIRDS OF THE INDIAN EMPIRE.

BY

E. C. STUART BAKER, F.Z.S., F.L.S., M.B.O.U., H.F.A.O.U.

VOL. V.

THE WADERS AND OTHER SEMI-SPORTING BIRDS.

PART XIV

(With a colour plate)

(Continued from page 876 of Vol. XXXIV.)

GENUS : PLUVIALIS.

Pluvialis Brisson, Orn. i, p. 46; Vol. v, p. 42, 1760.

Type by taut. *Charadrius apricarius* Linn.

Superficially very like the genus *Squatarola*, without a hind toe. In this genus the bill is slender and short, with the dertrum but slightly swollen; the nostrils are linear and are placed in a groove which extends about two-thirds the length of the upper mandible; the wings are pointed, the first primary longest, the outer secondaries short and inner long and pointed; tail short and rounded; tarsi reticulated all round with hexagonal scales; outer and middle toes connected by a short web at their bases; the sexes are alike and there is a distinct breeding plumage.

Key to Species.

- | | | |
|-----------------------------|-----|----------------------------|
| A. Axillaries pure white | ... | ... <i>P. apricarius</i> . |
| B. Axillaries greyish-brown | ... | ... <i>P. dominicus</i> . |

PLUVIALIS APRICARIUS.

In October, 1921, Mrs. A. C. Meinertzhagen separated the bird breeding in the British Isles under the name of *C. a. oreophilus* on account of certain minor differences in the breeding plumage. As all our Indian specimens in the British Museum are in non-breeding plumage, it is impossible to say to which race they belong, until more material is available. Under the circumstances I only include the more Eastern form, which is the one we should expect to see.

PLUVIALIS APRICARIUS APRICARIUS.

The Golden Plover.

Charadrius apricarius—Linn., Syst. Nat. 10th ed., i, p. 150 (1758) (Oeland, Sweden).

Charadrius pluvialis.—Blanf. and Oates. iv, 235.

Vernacular Names.—*Chota Battan* (Hind.)

Description: Breeding Plumage.—Forehead and lores yellowish-white, spotted with brown; short supercilia yellowish; whole upper plumage blackish-brown, each feather with a golden tip and spots along the edges, giving the whole a spangled gold appearance; primaries blackish, the shafts brown with a white patch near the tip, this white extending on to the inner webs in the innermost; in freshly-moulted birds there is a fine edging of white to the tips; sides of the head mottled white, brown and gold; chin white; throat, fore-neck and vent black, surrounded by a narrow broken white band; flanks like the back; axillaries and under tail-coverts white, the latter spangled with gold and brown except in the centre.

Colours of soft parts.—Iris brown; bill, legs and feet black.

Measurements.—Wing 181 to 194 mm.; tail 60 to 75 mm.; tarsus 37 to 42 mm.; culmen 21 to 26 mm.

In Winter the upper parts are sometimes rather duller; the chin and throat are white, faintly streaked darker, the breast is mottled gold and brown, the gold disappearing on the lower breast, which with the flanks are white with brown bars; centre of abdomen, vent and under tail-coverts white, the latter tipped and barred on the lateral feathers with gold and brown.

In many specimens the gold on the breast is replaced by brown-grey.

Young birds are like the adult in non-breeding dress but have the underparts darker, the breast more marked with brown and the posterior flanks and abdomen barred with brown and marked faintly with pale gold.

Nestling in down.—Mottled gold and black above, except on the hind-neck, which is white or nearly so; below dull white.

Distribution.—Europe, Northern Africa, Western Asia to Lake Baikal, migrating South to Tropical Africa and India East to Assam.

To India the Golden Plover is only a rare visitor, occurring occasionally between October and March. Specimens have been shot at Quador and Baluchistan, Karachi, Lehwan and, again near Lucknow, a single specimen was obtained by Capt. Hanna, whilst, finally, I myself shot two specimens in Dibrugarh in Assam. This

is the only occasion it has been found so far East, practically all the other records of its occurrence being confined to the North-West of India.

Nidification.—This Plover breeds over the greater part of Northern Europe as far East as Western Siberia, the Yennessei and Lake Baikal where throughout the extreme eastern portion of its habitat, particularly to the east of the Ural Mountains, it may be found breeding in company with the next bird, the Eastern Golden Plover, many of the so-called eggs of the latter bird offered for sale being really those of the former. In the southern portions of its breeding range the Golden Plover commences to lay about the 20th of April and on into the middle of May, whilst in the northern portions fresh eggs may be found up to the third week in June. The nest is either a natural hollow or one scraped out by the birds themselves and is well-lined with grass, heather or whatever vegetable material may be obtainable in the immediate vicinity. Rarely the nest is placed in no hollow but merely consists of beaten herbage matted together and lined with a few leaves and a little grass. It is almost invariably well concealed and extremely difficult to find, for it is almost impossible to catch the bird on the nest unless the eggs are nearly on the point of being hatched. I have, however, on more than one occasion, found them by making a man walk across a likely area, keeping my field-glasses fixed about a hundred yards ahead of him, when sometimes I was lucky enough to spot the bird as she sneaked off, running quietly through the grass for a considerable distance before she flew away. I then kept perfectly quiet until the man had passed well beyond the site of the nest after which the hen bird would run back and squat on her eggs. Approaching her very quietly, I sometimes found her so intent on keeping the other man in view that I was able to get within about 10 yards before she rose from her nest and fell flopping about on the ground as if with a broken wing, trying to draw me away from her eggs. These antics are not often indulged in by the bird when she has eggs in the nest, but if an intruder stands over the nest for any length of time, or if she has chicks hidden in the grass nearby, both cock and hen birds will return to the nest, flying round and round, uttering their sad little call, whilst the female will frequently alight on the ground and try to draw the intruder away by feigning illness or injury. The site selected for the nest is almost invariably wet upland, and even in Norway, Sweden and Finland, the nest is nearly always placed on a rise or high ground but, unlike so many other birds in these countries, they prefer entirely open country to that which is more or less covered with stunted tree growth.

The full clutch of eggs is four, and they are in shape the usual broad pyriform common to the family. They are extremely handsome, varying in ground colour from a pale fawn, cream or almost white, to a rich buff, whilst the markings consist of large bold blotches and spots of deep Vandyke brown, chocolate brown, black, or deep blood colour. In a few eggs, there is a chestnut tinge both in ground colour and markings. The blotches are generally more numerous and largest on the larger half of the egg, where they sometimes form more or less of a cap. As this bird has only recently

been separated from the British form, nearly all the measurements which have been given so far are those of both races, but Rey gives the average of 26 continental eggs as 51.4×34.1 mm.

Habits.—In India, the Golden Plover is only found either singly or in very small flocks, though it may associate occasionally with other waders, indeed the two birds which I obtained in Dibrugarh were shot out of very large flocks of the Eastern Golden Plover, three of these birds falling to my first shot and five to my second. Fortunately it was as the birds were just leaving for the North and the majority were in full breeding plumage though the difference in the colour of the axillaries always makes determination of the species very easy. In the Winter in countries where it is more numerous, the Golden Plover often associates in flocks of many hundreds, whilst during migration, both North and South, it collects in great numbers; though almost immediately it arrives at its breeding grounds, the flocks break up and the birds are only to be seen in pairs. Nesting operations commence almost directly the birds arrive in the North and they do not assemble again in flocks until just prior to their leaving again for the South. This bird is essentially a game bird, for it is amongst the hardest of birds to approach, flies very strongly and, when shot, forms a quite first class dish for the table.

The ordinary call is a shrill but very pleasant *tuill-tuill* constantly repeated when on the wing. The warning cry, which is uttered by the bird upon some little eminence not far from the nest, is a sad, rather drawn-out *tu-ee, tu-ee* repeated at short intervals until he thinks the intruder has come too near the nest to be safe, when the note is sharpened and quickened and the hen bird at once sneaks away. The Golden Plovers' food consists of all kinds of insects, beetles, berries and shoots of many plants and, when feeding by the sea, of small mollusca, crustaceans and sea-worms.

PLUVIALIS DOMINICUS.

Charadrius dominicus Muller, Natur. System. Suppl., p. 116 (1776)
Type-locality; St. Domingo.

The typical form differs from the Eastern in having the upper parts more golden and also in having a longer and stouter bill.

PLUVIALIS DOMINICUS FULVUS.

The Eastern Golden Plover.

Charadrius fulvus Gmelin, Syst. Nat., i, (2) p. 687 (1789) Tahiti; Blauf. and Oates, iv, p. 234.

Vernacular Names.—*Chola-battan* (Hind.); *Kotan* (Tam., (Ceylon); *Rana Watuva*, *Oliya*, *Maha Oliya* (Sing.)

Description: Breeding Plumage.—Forehead broadly white running back as a broad white supercilium and down the sides of the neck and breast; lores black; axillaries greyish-brown edged and tipped with white and centered darker. Otherwise similar to the preceding bird but with less gold spangling, especially on the wings.

Colour of soft parts as in the Golden Plover.

Measurements.—Wing 160 to 165 mm. ; tail 60 to 64 mm. ; tarsus about 40 to 44 mm. ; culmen 22 to 27 mm.

In Winter differs from the Golden Plover in being a little duller above and in always having grey axillaries.

Distribution.—Breeding in Siberia from the Kara Sea to West Alaska and south to the Amoor River. In Winter south to India, Burma, and Malay Peninsula and Archipelago, the Indo-Chinese countries and South China to Australia. In India it occurs as far south as Ceylon, where Wait records it as common throughout the Low Country. In Burma it is common from North to South.

Nidification.—The Eastern Golden Plover breeds practically throughout Siberia, in its western part sharing its breeding grounds with the European Golden Plover. In its nesting habits, it apparently differs but little from the previous bird, selecting similar sites for the nest and being just as difficult to approach. Seebohm records it as being about the most common bird at Golchika but he was never able to disturb the bird on its nest or to obtain eggs, though he obtained the chicks in down. The nest is the usual shallow depression well lined with whatever grass, weed or lichen may happen to be growing near, and well hidden. The bird appears to breed principally on the flats bordering rivers and on higher ground, further from them. The number of eggs laid is the usual four in a clutch, though McFarlane once obtained five. They differ from those of the European Golden Plover in being decidedly smaller and almost always more dull and paler. Judging also from the small number of eggs I have been able to examine, the markings are less bold and handsome.

Three clutches, each of four eggs, in my own collection were taken at the end of June or in the first week in July. Twenty-one eggs, including seven measured by Jourdain, average 47.6×33.4 mm., maxima 50.0×32.7 mm. and 48.3×35.6 mm., minima 45.0×31.8 mm. The breeding season seems to be from the first week in June to at least the second week in July and I have seen no eggs that are absolutely authentic, taken before the second week in June.

There is nothing to prove that the Eastern Golden Plover has ever bred within our limits or even within the limits of the Himalayas, but I have twice had eggs sent me from the Gyantse Plain which seemed to be undoubtedly those of a Golden Plover of some sort. Unfortunately in neither case were the birds shot and, so far as I could ascertain, the layers were either not seen at all, or were not seen sufficiently near to give any chance of identification. The eggs were taken at an elevation of about 13,000 feet and it is just possible that a few Eastern Golden Plover may remain on these lofty plains throughout the summer.

Habits.—In India this plover is comparatively common in the North-East, often occurring in very large numbers in Assam and Bengal, becoming more rare towards the West, though it is found as far as Sind and the North-Western Provinces. It extends south to Ceylon, whilst throughout Burma and further east, it is common. The first few birds of this species used to arrive in Assam in early September and I have records of its being shot as early as the last week in August, these latter being nearly always

birds of the year with no signs of breeding plumage on them, whereas the birds which arrived later occasionally had the remains of the black breast still visible. The birds soon lose this and begin to acquire it again in March and by the time they leave in April have often acquired the full breeding dress, in fact it was often noticeable that when feeding, the flocks often broke up into pairs, though these at once mixed with the main flock directly they were disturbed. In Assam and Burma, where it was probably more common than anywhere else during the Winter, it was often found in flocks of several hundreds and the larger the flocks the more difficult it was to approach. As a rule if we wanted to circumvent such a flock, our plan was for one of our party to detach himself from the rest who hid in any cover available, whilst he made a big circle round to the other side of the flock. In this way two or more guns often got a number of shots, whilst even the man deputed first to disturb them, provided he dropped to the ground quickly and hid himself, often obtained a right and left after the birds wheeled round on being first shot at. I do not know whether it is really so, but these birds always give me the impression of flying in very much more compact flocks than the European birds do and in consequence it was often possible to drop several birds in one shot without indiscriminate 'browning'. I have often myself obtained more than one bird in a single shot whilst Dr. Moore told me that once he had shot eleven, and on another occasion I saw Mr. C. Holder drop seven birds out of a flock which by chance crossed him when he was shooting Green Pigeon. The food of this Plover is the same as that of *P. a. apricarius* but those I examined had fed very largely on small grass-hoppers and tiny coleoptera. Its note is said to be more like that of the Grey Plover than the Golden Plover. Seebohm and others describe its note as a plaintive *Ko*, sometimes prolonged into a mournful *Ko-ee*. The only note which I know is that uttered during the winter when the bird is in flocks and this is a very charming double whistle, sounding like a soft though high pitched *Tu-ee, tu-ee*, uttered constantly by the bird both as the flocks take to wing and again before they pitch, or less often, as they start on their flight.

GENUS: VANELLUS.

Vanellus Brisson, Orn. i, p. 48 (1760).

Type by taut., *Tringa vanellus* Linn.

This genus is distinguished from all other genera in the *Vanellinae* by the presence of a large recurved crest and by the absence of either lappet or wing-spur.

The bill is short and slender, with a flattened culmen and slightly swollen dertrum; the linear nostril is placed in a groove which extends over more than half the upper mandible; the wings are very rounded. In the male, the third primary is longest and the second equals the fourth; in the female, the second and third are longest and the first equals the fourth; the tarsus is moderate and reticulated all round; there is a small hind toe.

The genus contains but one species, which extends over the greater part of the Temperate Old World.

VANELLUS VANELLUS.

*The Lapwing, Peewit, or Green Plover.**Tringa vanellus* Linn., Syst. Nat., 10th ed., i, p. 148 (1758) (Sweden).*Vanellus vulgaris*.—Blanford and Oates, iv, p. 130.*Vernacular Names*.—None recorded.

Description: Breeding Plumage.—Face, forehead, crown and long crest of narrow feathers black, glossed with green; feathers round the eye, lower ear-coverts, sides of the head and neck white; a black patch from the black face to the upper ear-coverts; back, rump, scapulars and innermost secondaries bronze-green, highly glossed; the scapulars marked with violet-purple; upper tail-coverts cinnamon; tail white with a very broad black subapical band glossed green; wing-coverts glossed deep blue, purplish in some lights; primaries and outer secondaries black with pale brown tips to the first four primaries; throat, fore-neck and breast black, the black running up to the back on the anterior neck; under tail-coverts cinnamon; under wing-coverts black; remaining lower plumage and axillaries white.

Colours of soft parts.—Iris brown; bill black; legs and feet orange-brown.

Measurements.—Wing 220 to 236 mm.; tail 108 to 119 mm.; tarsus 44 to 48 mm.; culmen 23.0 to 26.5 mm. (Hartert).

In non-breeding plumage the crown is brown rather than black; the face, chin, throat and fore-neck are white, more or less speckled or marked with brown or black; the scapulars, inner wing-coverts and innermost secondaries are edged with fulvous as are the black feathers of the breast.

Young birds have the upper parts brown, each feather edged with fulvous; the back is slightly glossed with purple-bronze and the wings with green; lower plumage like the adult in Winter.

Nestling in down.—Hind-neck dull white, remaining upper parts fulvous-brown, mottled with black; a black line from eye to eye round the back of the crown; a broad, but broken median black line down the back and a fairly well-defined black line from wing to wing bordering the back and round the tail; a black line from the side down the thighs; upper fore-neck blackish; remaining underparts white or dull fulvous-white.

Distribution.—The whole of Europe and North Asia. In Winter South to North Africa, India, Burma, the Indo-Chinese countries and South China. In India it is comparatively common in the Punjab and North-West. It is a regular, though not common, visitor to Assam and Eastern Bengal and has also been shot in Burma.

Nidification.—The Lapwing is one of the earliest of breeding birds and in the southern parts of its breeding areas eggs may be taken at the end of March and sometimes as early as the last week in February. The majority of eggs will, however, be found in early April or, in the further North, in May. Like all Plovers, the Lapwing deposits its four eggs in a natural hollow in the ground, sometimes, however, scraping out one for itself. The hollow may be absolutely unlined, or it may be so well lined with grass, bracken, or other

material that it can almost be said to form a good nest. When breeding, as it so often does, in fallow fields on rising ground, the bird usually selects the crest of a rise and to those who know its habits well, it is often easy to go straight to the portion of the field where its eggs are most likely to be found. On the other hand it often breeds in the flat sea-side marshes and low-lying river lands. The eggs vary most extraordinarily in colour, the ground colour may be anything from a pale yellowish stone, pale olive brown or greyish brown to a warm buff or stone colour, whilst the markings differ in various eggs from tiny specks to bold blotches. They are generally distributed fairly numerous over the whole surface of the egg but in some cases, especially where the markings are bold, they are less profuse, leaving the ground colour visible in big patches. Occasionally erythristic eggs are obtained and more often eggs almost entirely of a pale blue-grey, showing a complete absence of superior or more superficial colouring. In shape the eggs are broad peg-top, whilst a hundred eggs average 47.0×33.7 mm., maxima 58.0×32.5 mm. and 47.4×37.2 mm., minima 42.3×33.5 and 44.7×31.2 mm.

It would be difficult to find any bird more shy or difficult to approach when nesting and it is practically impossible to approach within sight of a sitting bird. The male bird is invariably on the *qui vive* against all intruders giving warning to his mate long before their approach becomes dangerous. When the young are hatched, however, their great anxiety often conveys a clue to where these are lying hid.

Habits.—In India, the Lapwing is fairly common during the cold weather from October to March, in the North-West extending as far as the United Provinces. East of this it extends in fast decreasing numbers as far as Cachar and Lakhimpur, south and east of the Brahmapootra, in both of which districts I have personally shot specimens. In Europe it often collects in flocks of immense size before migrating; but in India, even in the North-West, only small flocks are seen and very often only pairs or single birds, whilst when one gets to Assam, the latter only are met with. It extends south on the West to the Bombay Presidency but in the East, not, I think, further south than Bengal whilst even there it is extremely rare. It is capable of great speed in flight when necessary but for the most part it saunters along at a very leisurely pace, whilst in the breeding season, it indulges in most extraordinary evolutions in the air, emulating the most modern stunts of our aviators. Its well-known call has been syllabified into the name of *Pee-wit* but its cry is really more of a mew than this word expresses. It is a plaintive, wild note and once heard, is alone almost sufficient to identify the bird for a certainty. It feeds on all kinds of insects, worms and beetles and is a great destroyer of wire-worms on ploughed land, where, because of this, it is of the greatest value to farmers. On the other hand many of its former haunts have now been rendered uninhabitable by the use of slag manure which destroys its food and drives the bird away to other quarters. Its eggs are famous all over Europe as an article of food but in England their sale has now been made illegal, a well-meant measure which may, however, act more against than in the interests of the bird, as with such early breeders, many of the first eggs laid are destroyed by frost and cold and again, many of the

young first hatched are starved because of the insufficiency of food generally available. A more effective measure would probably have been to restrict the taking of their eggs up to some date such as the first or tenth of April.

GENUS : CHETTUSIA.

Chettusia Bonaparte, Icon. Faun. Ital. Livre 23, (1838) Type by mon., *Charadrius gregarius* Pallas.

When writing the *Fauna* of India, I retained, with some doubt, the two species included in this genus by Blandford. The two differ both in colour and in structure rather definitely and *Chettusia leucura* should perhaps be separated under the generic name *Eurypterus* of Sharpe.

This genus differs from *Vanellus* in having no crest and in having much white on the wing ; in *C. gregaria* the tarsus is reticulated but in *C. leucura* the reticulations become small scutellations.

Key to Species.

- | | | |
|---|-----|--------------------|
| A. Some black on the tail ; a broad white supercilium ... | ... | <i>C. gregaria</i> |
| B. Tail all white ; no supercilium ... | ... | <i>C. leucura</i> |

CHETTUSIA GREGARIA.

The Sociable Lapwing.

Charadrius gregarius Pallas, Reise Reichs. Russ. i, p. 456 (1771) (Volga).

Chettusia gregaria.—Blanf. and Oates, iv, p. 231.

Vernacular Names.—None recorded.

Description : Breeding Plumage.—Forehead and broad supercilium white ; crown, lores and a line behind the eye black ; hind neck narrowly white, meeting the supercilia ; chin white ; upper plumage, throat and breast light ashy-grey ; upper tail-coverts white ; tail white, the central feathers suffused with grey ; wing-coverts ashy-grey, the greater secondary-coverts broadly edged white ; primary-coverts and primaries black ; the latter with concealed black bases and the innermost one or two with white tips and edges to the inner webs ; outer secondaries pure white, inner like the back ; lower breast black, the longest anterior feathers chestnut ; vent, posterior flanks, abdomen and under tail-coverts white ; tail white with a broad black band on all but the two outermost pairs of feathers and with only a black patch on the inner webs of the third outer pair.

Colours of soft parts.—Iris brown ; bill, legs and feet black.

Measurements.—Wing 196 to 204 mm. ; tail 84 to 91 mm. ; tarsus 59 to 62 mm. ; culmen 29 to 31 mm.

In non-breeding plumage, the crown is brown, the feathers sometimes showing black centres ; the forehead and crown more or less buffy-white ; chin and throat white ; breast smoky-grey, mottled with brown ; abdomen, vent and posterior flanks smoky-white.

Young birds like the adult in non-breeding plumage, the feathers of the upper parts edged with light rufous.

Distribution.—South-Eastern Russia and Asia as far as Central Siberia, migrating south to North Africa and India and west to Western Europe.

It occurs as far south as Ceylon and has been obtained on several occasions in that island.

Nidification.—The breeding of the Sociable Lapwing very closely resembles that of the Common Lapwing. Its breeding area extends from South Central and Central Russia, through Asia Minor to Eastern Turkestan and South-West Siberia, and—rarely—to South Central Siberia as far Tomsrk. The bird almost invariably selects wide open spaces of uncultivated or semi-cultivated country but occasionally also breeds in cultivated fields before the crops have attained any height. In the Crimea it is said sometimes to breed in potato fields. The nest is merely a scraping in the ground like that of our Lapwing, often quite unlined except for a small amount of fallen rubbish, but at other times is a comparatively well-made nest of grass and weeds. This is more especially the case when the site chosen is one in wet bog-land or on the muddy shores of lakes and rivers. There are a few birds who breed in Southern Russia as early as the middle of April and I have a clutch taken in Turkestan on the 26th of March. A favourite time, however, seems to be from the middle of May to the middle of June. A few birds lay, possibly second clutches, as late as July. The eggs may, in almost every instance, be duplicated by those of our English Lapwing but, taking them as a whole, the pale grey or cyanic type of egg is much more common and, at the other extreme, very dark eggs with a greenish ground colour are not rare. I have seen no erythristic eggs of this bird but I believe there are such in existence, as for instance, in the Museum in Leningrad. In shape the eggs are the normal blunt pyriform of the family. Eighty-five eggs average 46.2×33.5 mm.; maxima 49.4×31.9 mm. and 47.1×34.1 mm.; minima 43.1 by 32.3 mm.; 44.9 by 31.3 mm.

The bird is said to be shy and to leave its nest long before any intruder approaches within sight, sneaking quietly away for some distance before it rises. When, however, the young are hatched, the old birds always give away their vicinity by circling round over them uttering their loud complaining call. At the same time it is far less shy than our English bird, so much so that some observers have said that with reasonable precaution it is possible to approach within quite a short distance of the sitting hen.

Incubation is said to take about 24 days.

Habits.—In flight, food and manners generally, the Sociable Lapwing is very much like our Lapwing but in India, at all events during the non-breeding season, it is very much less shy. In India it is not uncommon in the North-West, ranging south as far as the Southern Bombay Presidency and east to the United Provinces, Behar and Western Bengal. Within our limits it is found either in small parties or in pairs, or single individuals mixed with other Plover. Before migrating from its breeding habitat it is said to assemble in vast

multitudes, whilst even in Mesopotamia and parts of Persia it occurs in very great numbers.

One of my correspondents speaks of seeing 'many hundreds' in Persia.

The call is a single harsh wailing note, frequently uttered both on the wing and when the bird is on the ground, whilst its alarm note is a quick loud single call. Its flight, although like that of the Lapwing, is quicker, more direct and consists of a rather more rapid beating of the wings, at the same time it often indulges in aerial revolutions, very similar to the Lapwing's courting flight.

CHETTUSIA LEUCURA.

The White-tailed Plover.

Charadrius leucurus Licht., in Eversm., Reise, av. Orenb. nach Buchara, p. 137 (1823) (Kuwan).

Chettusia leucura.—Blanf. and Oates, iv, p. 233.

Vernacular Names.—None recorded.

Description.—Upper plumage light brown, suffused with a purple pink, except on the head and hind-neck; forehead and indistinct supercilia pale greyish-white; upper tail-coverts and tail pure white; median and greater wing-coverts with broad black bars and white tips forming four wing-bars; primaries black; outer secondaries white, with broad black bars gradually decreasing in width until the central feathers are all white and thence grading into the innermost, which are like the back; chin, throat and fore-neck ashy-grey; breast purer grey; abdomen, vent and under tail-coverts rosy-white or rosy-buff; axillaries white.

Colours of soft parts.—Iris brown or blood-red; bill black; legs pale yellow.

Measurements.—Wing 169 to 179 mm.; tail 73 to 78 mm.; tarsus about 72 to 77 mm.; culmen 28 to 31 mm.

Young birds have the upper parts very dark brown, the feathers with broad fulvous edges; the underparts like the adult but pale and looking very washed out.

Distribution.—Breeding throughout Mesopotamia, Persia, Turkestan and Transcaspiæ. In winter South India and North Africa.

Nidification.—Pitman found this Plover breeding in large colonies in Mesopotamia from the middle of May to the end of June, whilst Cox and Cheeseman took eggs, probably second layings, in July. The birds nest on the shores and higher pieces of ground in and around swamps or by lakes. At Meseyib, Pitman found a colony of several hundred pairs breeding on a part of the great swamp, laying their eggs wherever there were a few feet of mud or dry land above the surrounding water. So numerous were the birds that on some patches of island only a few feet across, four or five pairs of birds were breeding together. The nests were just the usual scratchings in the earth, lined with grass and weeds, in a few cases with shells or, occasionally, quite unlined. There appeared to be no attempt at concealment, for though in some cases the eggs were partially hidden by tufts of grass, in others they lay in the open nest quite exposed. The eggs numbered three or four, the latter as often as the former

and, in appearance, are very much like small dull-coloured Pee-wits' eggs, rather more oval and narrow and less peg-top-shaped than most Plovers' eggs. In the majority of the eggs the ground-colour is a pale dull clay, in a few eggs tinged with olive. The markings consist of fairly bold blotches, spots and smudgy dots of blackish or reddish-brown distributed freely over the whole surface. The secondary markings consist of pale grey or lavender blotches, always few in number and sometimes absent altogether.

Eighty eggs average 39.5×28.3 mm.; maxima 43.2×29.0 mm. and 41.3×29.2 mm., minima 37.5×28.1 mm.; and 38.8×27.0 mm.

Pitman says that, though shy, he often saw birds sitting on their nests until he was quite close to them and that when disturbed the birds were quickly back again as soon as he left the place. Logan Home says that the birds in the colonies he found at Abu Aran on June 8, were very shy and that, unlike the Pratincoles and Little Terns which were also nesting there, the Plovers were very wary and would not go on to their nests so long as he stayed on the island. Bird observers describe them as very noisy at their breeding grounds, constantly wheeling round uttering loud cries. In parts of the Euphrates Valley these birds breed in company with Stilts but make less of a nest and generally select drier ground on which to make it.

Habits.—The White-tailed Plover is found much more commonly in India than the preceding bird, occurring mostly in the Punjab and North-west India, and extending South to Mysore and East to Calcutta and Dacca, from both of which places I have seen specimens. Unlike more of our Plovers, this bird is essentially a swamp lover and is seldom to be found at any distance from marshes and lakes, though occasionally it may be found feeding on cultivated land, especially wet ploughed land. It assembles in flocks of considerable size in Sind and the Punjab, but to the East and the South it occurs only in small parties or as single stragglers. When in flocks, it is very shy and difficult to approach but single birds seem to be much less wild and, when in company with other waders and plovers, can often be approached within shot. It feeds very largely on water insects, worms, grubs and tiny freshwater shrimps and mollusca. Its flight is very similar to that of the Sociable Plover, as is its voice, and it is said to be quite as noisy as that bird especially in the breeding season.

(To be continued).

REVISION OF
THE FLORA OF THE BOMBAY PRESIDENCY.

BY

E. BLATTER, S.J., Ph.D., F.L.S.

PART XV

(Continued from p. 900, Vol. XXXIV.)

(With 7 plates).

ARACEÆ (Cke. ii, 816).

BY

E. BLATTER S.J., Ph.D., F.L.S. & C. McCANN, F.L.S.

Genera 107. Species 1000.—Tropical and temperate.
Cooke mentions 11 indigenous genera. We add *Rhaphidophora* as new to the Presidency and treat *Colocasia* as an indigenous genus. We are not considering the cultivated species.

Key, partly after Cooke :

- A. Flowers 1-sexual, monœcious (often dicecious in *Ariscema*).
- I. Water or marsh plants. Spadix without a barren appendix.
 - 1. Floating stemless herbs ; leaves forming a rosette-like tuft ... 1. *Pistia*.
 - 2. Submerged aquatic or marsh herbs
 - (a) Ovaries in one whorl ... 2. *Cryptocoryne*.
 - (b) Ovaries spirally arranged ... 3. *Lagenandra*.
- II. Terrestrial tuberous herbs.
 - 1. Spadix with a barren terminal appendix
 - (a) Ovules not parietal
 - i. Male flowers stipitate ; flowers often dicecious ... 4. *Ariscema*.
 - ii. Male flowers sessile or nearly so ; flowers always monoecious
 - (1) Flowers and leaves present together
 - (i) Ovules 1-2, basal ... 5. *Typhonium*.
 - (ii) Ovules many, basal and apical. 6. *Theriophonum*.
 - (2) Flowers appearing before the leaves
 - (i) Ovules orthotropous ; males and females remote ; neuters present ... 7. *Saurumatium*.
 - (ii) Ovules anatropous ; males and females contiguous ; neuters 0. 8. *Amorphophallus*.
 - (b) Ovules many, parietal ... 9. *Colocasia*.
 - 2. Spadix without a barren appendix ; ovules parietal
 - (a) Female inflorescence adnate to base of spathe, stigma stellate. 10. *Ariopsis*.
 - (b) Spadix free from the spathe ; stigma discoid ... 11. *Remusatia*.

- B. Flowers hermaphrodite, a few rarely uni-
sexual. Perianth 0.
Spadix without an appendix, sessile ;
ovary 1—2-celled ; berries confluent ... 12. *Rhaphidophora*.
- C. Flowers hermaphrodite. Perianth of 4-6
segments. Spadix without an appendix,
flowering upwards. ovary 1-3-celled ; stem
scandent, leaves distichous ... 13. *Pothos*.

1. *PISTIA*, Linn.

Species 1.—Tropics and subtropics, with the exception of Polynesia and Macronesia, sometimes ascending up to 5,000 or 5,800 ft., mostly in the plains, sometimes also in somewhat brackish water.

The Bombay plants all belong to the following variety :

Pistia stratiotes, Linn. Sp. Pl. (1753) 963, var. *cuneata* Engl. in Fl. Bras. III, 2 (1879) 214.—*P. stratiotes* Linn. ; Roxb. Corom. Pl. III (1819) 63, t. 269 ; Fl. Ind. III (1832) 131.—*P. crispata* Bl. in Rumphia I (1835) 78.—*Koddapail* Rheede Hort. Malab. XI (1692) 63, t. 32.—*Kiambam kitsii* Rumph. Herb. Amb. VI, 177.

Leaves almost obtriangular, tip rotundate, slightly emarginate, the upper margin slightly crisped or not crisped.

2. *CRYPTOCORYNE*, Fisch.

Species 40.—Indo-Malayan. Marsh plants.

Cooke mentions 3 species : *C. retrospiralis*, *C. spiralis*, *C. cognata*. We add 4 more not known from the Presidency before and describe 2 new ones.

- A. Upper tube of spathe almost absent or much shorter than the lower tube
- I. Leaf-blade broadly lanceolate. Blade of spathe spirally twisted from the base ... 1. *C. Huegelii*.
 - II. Leaf-blade linear-lanceolate or linear-ob lanceolate. Blade of spathe more or less spirally twisted from the base
 1. Blade of spathe with the margin entire ... 2. *C. unilocularis*.
 2. Blade of spathe with the margin denticulate
 - (a) Leaves up to 20 cm. long ... 3. *C. spiralis*.
 - (b) Leaves up to 85 cm. long ... 4. *C. tortuosa*.
- B. Lower tube of spathe slightly wider, below the upper tube more or less constricted
- I. Leaf-blade lanceolate to linear-lanceolate, acute at the base, gradually narrowed into the petiole
 1. Blade of the spathe long, linear-lanceolate, spirally twisted along the whole length ... 5. *C. retrospiralis*
 2. Blade of spathe ovate-lanceolate, contracted into a long subulate tail. Tube of spathe shorter than the long caudate lamina ... 6. *C. cognata*. - II. Leaf-blade broadly lanceolate-acuminate ... 7. *C. cognatoides*.
- C. Lower tube of spathe narrower than the upper tube and several times shorter ; blade broadly ovate-lanceolate, fimbriate-ciliate ... 8. *C. ciliata*.
- Imperfectly known species : Leaf-blade elliptic-lanceolate, acute at both ends ... 9. *C. Dalzellii*.

1. *Cryptocoryne Huegelii*, Schott Aroid. (1853) 8, t. 12 ; Prodr. (1860) 18 ; Hook f. F.B.I. vi, (1893) 494 ; Engler in Engl. Pflanzenr. iv, 23F (1920) 236.

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Description : Petioles 15-20 cm. long, vaginate beyond the middle. Leaf-blade oblong-elliptic, narrowed into the petiole, acute at the apex, 15-18 cm. long, in the middle 3-4 cm. broad, primary lateral nerves several, on either side, diverging at an acute angle from the midnerve. Peduncle 2-3 cm. long. Tube of spathe 20 cm. long, lower tube narrowly cylindric, 2.5 cm. long, 0.6-1 cm. wide, upper tube scarcely any, passing over into the blade. Blade linear-lanceolate, long acuminate, about 17 cm. long, 1.5 cm. broad below, inside with transverse, parallel, erose lamellæ, spirally twisted along its whole length. Female inflorescence 4-5-gynous, male 4 mm. long, thinly cylindrical, the interval between the two inflorescences about 1.2 cm. long; appendix short, stout. Ovary oblong, narrowed into a thin style; stigma oblong-oval.

Locality : Savantvadi (Dalgado in Herb. Calc.).

Distribution : The only other specimen is Huegel's No. 2446 in the Hof-museum Herb. Vienna, collected in the East Indies, but no definite locality is given.

2. *Cryptocoryne unilocularis*, (Roxb.) Kunth Enum. iii, (1841) 13; Wight Ic. iii, (1843) t. 774 (*non* Schott).—*Ambrosinia unilocularis* Roxb. Fl. Ind. iii, (1832) 493.—*Cryptocoryne Roxburghii* Schott Prodr. (1860) 18; Dalz. & Gibs. Bombay Fl. (1861) 257; Hook. f. F.B.I. vi, (1893) 494.—*Arum spirale* Grah. Cat. Bomb. Pl. (1839) 228.

Description : Caudicle about 5 mm. thick; internodes short. Petiole distinct, broadly vaginate, vagina passing into the blade, blade narrowly linear-acuminate, 20-30 cm. long, 0.5-1 cm. broad, lateral nerves sub-parallel with the midrib. Peduncle very short; lower tube of spathe oblong almost cylindrical, about 1.5 cm. long, 3.5-4 mm. wide, inside purple-spotted, upper tube narrower, 2 mm. wide and scarcely 1 cm. long; blade purple, narrowly linear-lanceolate, spirally twisted. Female inflorescence 4-gynous, male about 3 mm. long, separated from the female by a naked interval of about 1 cm.; appendix shortly conical. Ovary elongate-oblong; ovules biseriate. Style short, stigma oval. Capsule unilocular.

Locality : Konkan (Herb. Kew ex Engler).

Distribution : N. Circars, Konkan.

We have not seen any specimens. Roxburgh was the first to mention the plant from India, giving as locality 'Coromandel.' Graham mentions it in his Cat. Bombay Pl., but there is no specimen to confirm his identification. In Dalzell and Gibson's Bombay Fl. the species is mentioned as being common. This statement induces Cooke (Fl. Bomb. II, 819) to doubt its occurrence in the Presidency. It is certainly strange that a plant which is said to be common, should not have been seen during a period of 70 years.

Cooke says that Dalzell has supplied no specimen of this species and Haines has not found any at Kew. Engler mentions the same localities as Hook. f. in the F.B.I., viz., 'the Northern Circars and the Konkan', adding a mistake by including the N. Circars in the W. Ghats of the Malabar Coast. In addition, he gives as source for his information regarding the two localities the 'Herb. Kew.' If he relied on the F.B.I. the next question would arise whether Hook. f. has seen any specimens, and if he has not, why he included Graham's *Arum spirale* and Dalzell and Gibson's *Cryptocoryne Roxburghii* under Schott's *C. Roxburghii*? Their descriptions are certainly not such as to lead unmistakably up to *C. Roxburghii* Schott.

3. *Cryptocoryne spiralis* Fisch. ex Wydler in Linnæa v, (1830) 438; Bl. in Rumphia i, (1835) 84, t. 36 C.; Wight Ic. iii, t. 773; Schott Melet. (1832) 6; Aroid. (1853) 8, t. 13; Schnitzl. Iconog. fasc. iv, (1846) t. 72; Hook. f. F. B. I. vi, (1893) 494; Cke. ii, 818; Engler Pflanzenr. iv, 23 F (1920) 237.—*Arum spirale* Retz. i, (1779) 30; Bot. Mag. t. 2220; Lodd. Bot. Cab. t. 525.—*Ambrosinia spiralis* Roxb. Hort. Beng. (1814) 65; Fl. Ind. iii, (1832) 492.

Description : Caudicle 10-20 cm. long or longer, about 4-5 mm. thick, stoloniferous; internodes 1-1.2 cm. long. Petiole scarcely distinct, broadly vaginate, vagina passing over into the blade; blade linear-lanceolate, 10-15 cm. long, 8-12 mm. broad, long-narrowed from the middle to the base; lateral nerves ascending towards the apex. Peduncle very short, included together with the tube in a sheath. Lower tube of the spathe, including the inflorescence, obconical, about 2 cm. long, almost 1 cm. wide above, 7-8 mm.

below ; upper tube scarcely any ; blade purple, linear-lanceolate, 10 cm. long or longer, below more than 1 cm. broad, within strongly transversely lamellate, with a denticulate margin, purple, at first twisted, finally straight. Female inflorescence 5-gynous, male one 3-4 mm. long, separated from each other by a naked interval of about 8 mm. ; appendix shortly conical, 1.5 mm. long. Ovaries oblong, narrowed into a short, outward-bent style ; stigma broadly elliptic.

Locality : Khandesh : Bhusawal (Gammie !).—Konkan (Dalzell, Stocks).—Deccan : Poona (Herb. Econ. Bot. !).—N. Kanara : Santgul (Talb. 860 ! Herb. Calc.) ; Siddhapur in rice fields, 1,500 ft., rainfall 100 in. (Sedgwick 7066 !, 7066b !).—It grows on the margins of ditches and ponds and in rice fields, submerged during the rains.

Distribution : From Khandesh to N. Kanara, Calicut, Coromandel Coast, Pondicherry, Bengal, E. Bengal, Ceylon.

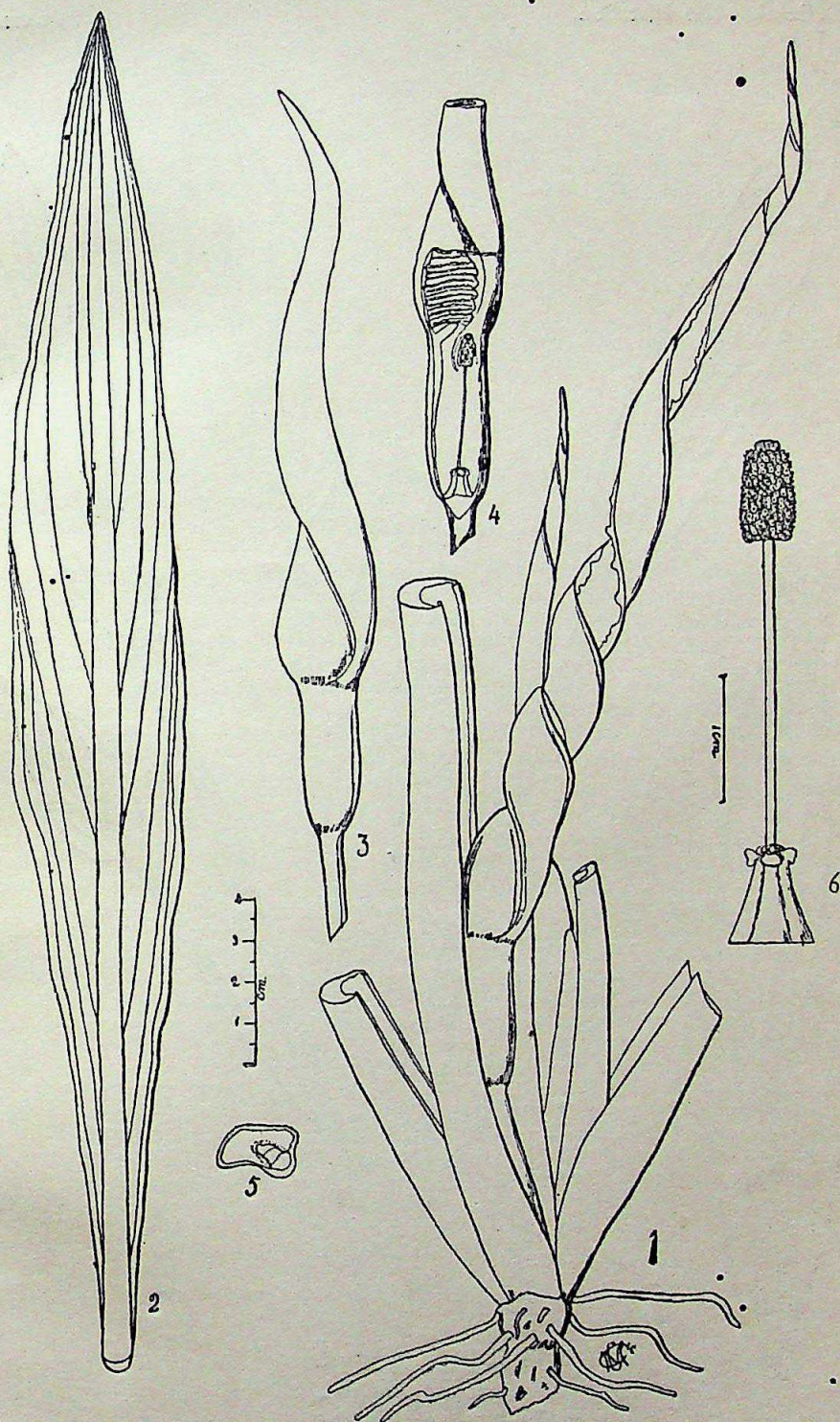
Flowers : Nov. (Poona) ; Dec. (Bhusawal).

4. *Cyrtocoryne tortuosa*, Blatter & McCann *sp. nov.* [*Pertinet ad sectionem Unitubulosarum* Engl. *Accedit ad C. Huegelii* Schott sed differt lamina foliorum lineari-lanceolata vel lineari-oblancoolata, foliis duplo longioribus pedunculo longiore, spathæ lamina coriacea margine denticulata inferne 8.5 cm. lata intus rugosissima, inflorescentia mascula longiore, interstitio inter inflorescentiam femineam et masculam maiore, stigmate discoideo margine sinuato, appendice minime truncata.]

A tall tufted herb. Rhizome 1.5 cm. thick, descending perpendicularly and getting thinner, with very long vermiform roots. Leaves including petioles up to 85 cm. long, upright, upper part of lamina slightly recurved. Petioles vaginate at base for about 20 cm., then deeply channelled with sharp edges for about 25 cm., fleshy, spongy, striate, 8 mm. diam. from dorsal to ventral side, 1.5 cm. from side to side, purple or pale green tinged with purple. Lamina slightly inequilateral, up to 40 cm. long and 6.5 cm. broad where broadest, dark green above, paler beneath, linear-lanceolate or linear-oblancoolate, apex acute or acuminate or subobtusate, sometimes apiculate, margin entire, very narrowly hyaline, undulate ; midrib very stout, semicylindrical, 5-7 mm. diam., striate, slightly depressed above, very prominent below, light green and striate with purple below ; lateral nerves 3 at base on either side running up for $\frac{1}{4}$ the length of the blade and disappearing into the margin, besides 3-7 on either side starting at different heights and running into the tip, all depressed above, prominent beneath, and communicating by transverse veins. Peduncle up to 8 cm. long, 8 mm. diam., cylindrical, slightly compressed, slightly thicker upwards, enclosed by a cataphyll and the vagina of a leaf. Cataphyll linear, membranous, 12 cm. long, 1 cm. broad, margins slightly incurved, tip rounded. Tube of spathe underground. Spathe up to 27 cm. long. Tube white or tinged with red purple, trigonous-cylindrical, flattened on the ventral side, convex on the dorsal 4 cm. long, 1.5 cm. broad transversely. Lamina thickly fleshy-coriaceous, stiff, brittle, lanceolate, long acuminate-caudate, 23 cm. long, up to 8.5 cm. broad at base, dark purple on both sides, spirally twisted from the base either to the left or the right (in bud the spathe is not twisted, then the lower part becomes twisted and in flower the whole blade, and finally it uncoils without spreading out entirely), lower part of blade very strongly rugose inside, diminishing upwards, the ridges in the lower part 2-3 mm. high, transverse, more or less parallel, purple, except sometimes for the lowest cm. yellowish ; margins of blade before opening out kept together by a row of teeth on each margin which are about 2-4 mm. long. Spadix 3.3 cm. long. Female inflorescence 6 mm. long, at base 7 mm. diam. ; ovaries 6, verticillate, connate ; stigmas irregularly discoid, cream-coloured, very minutely papillose, with the margins undulate and tinged with purple. Nude part of spadix between male and female inflorescences 2 cm. long, filamentous cream-coloured. Male inflorescence 7 mm. long, 3.5 mm. diam., cylindrical, yellow. Flowers diandrous. Stamens very short. Tip of spadix adnate to the septum of the spathe. Appendix white, truncate, about 1.5 mm. broad, scarcely 1 mm. long.

Locality : W. Ghats : Edge of a ditch at Lingmala near Mahableshwar, alt. 4,000 ft. (McCann 3331 ! type, 3335 !, 3336 !, 3340 !, co-types).

Flowers : 24th September 1930.



Cryptocoryne tortuosa Blatter & McCann, sp. nov.

- | | |
|----------------------------|---|
| 1. Plant with open flower. | 4. Section of flower. |
| 2. Leaf. | 5. T. S. showing septum with valve in tube. |
| 3. Bud. | 6. Spadix. |



Cryptocoryne cognatoides, Blatter & McCann, sp. nov.

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5. *Cryptocoryne retrospiralis* (Roxb.) Fisch. ex Wydler in Linnæa v, (1830) 428; Kunth Enum. iii, (1841) 12; Wight Ic. iii, t. 772; Cke. ii, 818.—*Ambrosinia retrospiralis* Roxb. Fl. Ind. iii, (1832) 492.

Description : Cke. i, 818.

Locality : Konkan : Bombay (Law) ; banks of the Pen River (Law) ; beds of rivers (Gibson) ; river-bed near Mira (Gibson 151).—Deccan : Poona, on river-banks (Perrotet, Ranade! Herb. Econ. Bot.!) ; Ganeshkhind Bot. Gard. (Patwardhan!).—N. Kanara : Nugi (Talbot 1583!, Herb. Calc.) ; Arbail (Talbot!).

Distribution : Konkan, Deccan, N. Kanara, Mysore, Travancore, Carnatic, Godavari District, Chota Nagpur, E. Bengal, Assam, Burma.

Flowers : Jan. (N. Kanara).

6. *Cryptocoryne cognata* Schott in Bonplandia, v, (1857) 222; Hook. f. F. B. I. vi, (1879) 494; Cke. ii, 819; Engler Pflanzenr. iv, 23F (1920) 247.

Description : Cke. ii, 819.

Locality : Konkan (Stocks). So far endemic.

7. *Cryptocoryne cognatoides* Blatter & McCann sp. nov.

[Pertinet ad sectionem *Bitubulosarum* Engler. Accedit ad *C. cognatam* Schott a qua tamen differt radice non tuberosa, foliorum laminis late lanceolato-acuminatis, basi acutis, vel cuneatis, vel rotundis vel subcordatis, nervatione, pedunculis multo longioribus.]

Herba rhizomate prædita 0.7 cm. crasso (non bulboso). Foliorum petioli 20 cm. attingentes vaginati; lamina late lanceolato-acuminata 20 cm. attingens, medio 2.3 cm. lata basi acuta, vel cuneata, vel rotundata vel subcordata, margine undulata, nervi 3 centrales a basi foliorum usque apicem currentes, laterales utrinque 3 adscendentes deinde in apicem exeuntes. Pedunculus 5.5 cm. longus. Spathæ tubus 5 cm. longus, inferne 7 mm., superne 5 mm. amplius, lamina late elongato-lanceolata, 5.2 cm. longa, minime tortuosa, intus transversaliter rugosula. Spadicis inflorescentia feminea 5.5 mm. longa, mascula vero ca. 4 mm. longa, ambæ interstitio 2.2 cm. separatæ; appendix conicus, brevissimus.

Locality : N. Kanara : In running water (T. R. D. Bell 3091! type, 3091a! 3091b! co-types).

Flowered in October 1917.

8. *Cryptocoryne ciliata* (Roxb.) Fisch. ex Wydler in Linnæa v, (1830) 428; Schott Melet. i, (1832) 26; Bl. in Rumphia i, (1835) 85; Wight Ic. iii, (1840-56) t. 775; Hook. f. F. B. I. vi, (1893) 492.—*Ambrosinia ciliata* Roxb. Corom. Pl. vii, (1819) 90, t. 294; Fl. Ind. iii, (1832) 491.—*Cryptocoryne elata* Griff. Not. iii, (1851) 434; Ic. Pl. As. (1851) t. 170, 171 (alata).

Description : Caudicle 1-2 cm. thick, stoloniferous; internodes very short, roots numerous, sometimes a longer internode between a series of shorter ones. Petioles 10-30 cm. and longer, 4-6 mm. thick, glabrous or papillulose, broadly (up to 2.5 cm.) sheathing. Blade above deep green (except the midrib), oblong-lanceolate or linear-lanceolate, inequilateral, 15-35 cm. long, 2-9 cm. broad, oblique at the base, acute or acuminate at the apex, midrib 3-5 mm. thick, very prominent on both sides, primary lateral nerves several on each side, scarcely prominent, passing away from the midrib at an acute angle. Peduncle very short, in fruit sometimes 5-6 cm. long; lower tube of spathe 1.5-2 cm. long, scarcely 1 cm. wide, upper tube 15-30 cm. long, 5-6 mm. wide, split at the apex, outside glabrous and dirty greenish, inside almost white, granulate towards the blade with many reddish papilli; blade ovate-oblong, 5-6 cm. long, 1.5-3 cm. broad, cuspidate, densely fimbriate with laciniae 5-6 mm. long and slightly crisped, at the throat with a yellowish ovate spot about 2 cm. long, otherwise purple. Female inflorescence about 5-7 gynous, 1 cm. long, covered by an ovate process of the spathe and separated by an interval of almost 1 cm.; appendix shortly broad-conical, about 3 mm. long, 4 mm. thick below. Ovary 8 mm. long, several-seeded; ovules biseriate, narrowed into a short outward-bent style; stigma linear-oblong. Syncarpium ovoid-globose, 3-4 cm. wide, 5-7-sulcate and crowded with 5-7 remnants of the styles, 5-7-locular, valvately dehiscent; cells 3-8-seeded, germinating in the fruit.

Locality : Western Ghats (T. Cooke! Herb. Calc.).

Distribution: Mysore, Coromandel, Carnatic, Calcutta, Sunderbunds, Malay Peninsula and Archipelago.

9. *Cryptocoryne Dalzellii* Schott in Bonplandia v, (1857) 221; Engl. Pflanzenr. iv, 23F (1920) 248; Cke. ii, 819 (*sub specie dubia*).

Description: Imperfectly known: Blade of leaf lanceolate, petiolate, apparently amplexicaul, the margin transparent and finally crenated; veins parallel; surface woolly as if covered densely with cobweb (Dalzell). Fruit ovoid, about 12 by 8 mm., on a solitary stalk; seeds biseriate, oblong, subtriangular.

Locality: 'Bombay' (Dalzell, Herb. Kew).

3. LAGENANDRA Dalzell.

Species 5.—India, Ceylon.

1. *Lagenandra ovata* (Linn.) Thwait. Enum. Pl. Zeyl. (1864) 334; Engler Pflanzenr. iv, 23F (1920) 228, fig. 57, 58.—*Arum ovatum* Linn. Sp. Pl. (1753) 967, ed. 2 (1763) 1371.—*Caladium ovatum* Vent. in Rømer Arch. ii, (1801) 357.—*Cryptocoryne ovata* Schott Melet. i (1832) 6.—*Lagenandra toxicaria* Dalz. in Hook. Journ. Bot. iv, (1852) 289, v, (1853) t. 4; Dalz. and Gibs. Bomb. Fl (1851) 257; Cke. ii, 819.

Description: Cke. 1 c.

Note: Leaves black in the shade, appressed to the ground (Sedgwick).

Locality: *Konkan*: In marshes (Dalzell); *Bombay* (Dalzell! Herb. Calc.); *Niwendi* river bank, Ratnagiri Dist. (Grade! Herb. Econ. Bot. Poona).—*S M Country*: Belgaum (Dalzell). *N. Kanara*: Yellapore (Talbot 1813! Herb. Econ. Bot. Poona); in streams and marshy places (Talbot 1012! Herb. Econ. Bot. Poona); in a stream above Malamaui Ghat (Sedgwick and Bell 7201!); Anmod, in nala (Sedgwick 3314!); Arbail Ghat (Sedgwick 3459!).

Distribution: From the Konkan to N. Kanara, Mysore, Coorg, Cochin, Travancore, Ceylon.

Flowers: Jan. and March (N. Kanara); May (Ratnagiri).

Fruit: Oct., Nov., Dec. (N Kanara).

4. ARISÆMA Mart.

Species 105.—Asia, Abyssinia, America.

Cooke has 4 species. We add 1 new to the Presidency: *A. neglectum*, and describe a new species: *A. longicaudatum*.

A. Appendix of spadix not exerted beyond the spathe

I. Leaflets sessile.

(a) Appendix of spadix tapering from the base to the tip

(b) Appendix of spadix narrowly clavate 1. *A. Murrayi*.

II. Leaflets petiolulate with thread-like tips. Spathe with a caudate tip.

(a) Appendix 1.5 cm. long 3. *A. caudatum*.

(b) Appendix 4 cm. long 4. *A. longicaudatum*.

B. Appendix of spadix far exerted beyond the spathe

I. Leaves pedatisect 5. *A. tortuosum*.

II. Leaves radiatisect... .. 6. *A. neglectum*.

1. *Arisæma Murrayi* (Graham) Hook. in Bot. Mag. (1848) t. 4388; Cke. ii, 821.

Description: We give a more complete description of this species from live material: Tubers hemispheric, up to 5 cm. diam., root-fibres crowded, arising from the upper side of the tuber, fleshy, white, rather tough. Sheaths broadly linear-oblong, or oblong-lanceolate, mucronate, lowest white, tipped purple, the others pale or dark purplish, the uppermost up to 30 cm. long, the lower much shorter. Leaf one, coming up shortly after the peduncle, but co-existent with the flower and finally reaching higher than the flower, peltate, glossy dark green on the upper surface, paler and shining beneath, divided to the base into 5-11 segments. Segments sessile, ovate-lanceolate-acuminate

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- or oblong-lanceolate-acuminate or obovate-lanceolate, cuneate at base, with 2 intramarginal nerves, the outer faint, the inner distinct and about 1 cm. from the outer, otherwise penninerved, the nerves from the midrib meeting the inner intramarginal nerve, all the nerves depressed on the upper surface and very prominent on the lower, the central one very pale green, margin either entire or dentate-sinuate and wavy, length from 6-15-45 cm., breadth 4-6-15 cm., acumen 1-5 cm. Petiole 30-90 cm. long, 2 cm. diam. below, 1 cm. near lamina (in a specimen 60 cm. high), cylindrical, striate, stout green or purplish-red or greenish-purple or green streaked with purple, sheathed for one half or less. Peduncle 30-90 cm., green or purple, cylindrical, thinner than the petiole, and slightly thinner towards the apex, shorter or longer than the peduncle. Spathe striate, up to 14 cm. long, tube cylindrical, 2-5-6 cm. long, 1-3 cm. wide, grass-green inside and outside with white striae, especially upwards, slightly constricted at top and there broadening into a broadly ovate-acute or ovate-acuminate, somewhat cucullate limb, limb up to 11 cm., incurved, sometimes at a right angle, at other times at 45° to the axis, pure white or sometimes with a green band or blotches along the centre, purple inside and outside where it meets the tube, the purple sometimes very faint or absent, especially outside, veins many, parallel, very distinct outside, faint inside, acumen mostly tinged with a bright green. Spadix narrowed from the base upwards, conical; appendage very variable 3-7 cm. long, greenish at base, becoming deep purple above and lighter in colour at the tip, exserted. (We have not seen it included in the tube), following more or less the bend of the limb, tapering to a fine point. Spadix androgynous or unisexual. Androgynous spadix: Female flowers below, crowded, covering about 2-3 cm. of the conical axis; ovaries arranged in many parallel spirals, sessile, style very short, stout, stigma disk-shaped, white; then follows an empty space of 3-4 mm. or the male flowers follow immediately, covering 1-2-5 cm. of the spadix, consisting of groups of 3-8, mostly 6 anther-lobes on a common very short stalk, sometimes a few subulate neuters above the anthers. Male spadix: Anther-bearing part up to 3 cm. long, 2-7, mostly 4 anther-lobes on a common stalk about 2 mm. long, globose or shortly ovoid, opening by a slit on top. Female spadix never seen. Ovaries when ripe, bright red, variously compressed.

Fruiting specimens showed the following measurements:

Tuber 8 cm. diam., whitish inside, producing young tubers from the upper side.

Petioles 80 cm. long; leaflets 27 by 13 cm.

Fruiting inflorescence first green, then yellow and finally red, up to 8-5 cm. long, 3-5 cm. wide. Styles persistent.

There is usually 1 leaf to a plant, 2 are not uncommon, 3 are rare.

The anthers are faintly scented.—The plants with male spadices are generally only half the size of those with androgynous spadices.

Locality: Gujarat: Bandsa Hill S. W. of Surat (Law).—Konkan (Stocks); Ambenali (McCann!) Matheran (Cooke!).—W. Ghats: Khandala (McCann!), Sedgwick 2616!, Bhiva!; Panchgani, very common (Blatter and McCann!); Mahabaleshwar, fairly common (Cooke!, Blatter!); Sinbhagad (Woodrow); Igatpuri (McCann!) Purandhar (Bhiva!).—Deccan: Satara (Talbot 3385!).

Distribution: Gujarat, Konkau, Deccan, W. Ghats, Nilgiris.

Flowers: July 1917 (Khandala), 7th July 1925 (Panchgani), 1st July 1925 (Panchgani), after first rains 1925 (Panchgani), Aug. 1894 (Satara).

Fruit: 25th Oct. 1917 (Igatpuri), Sept. 1917 (Igatpuri).

2. *Arisæma Leschenaultii* Bl. in Rumphia i, (1835) 93; Cke. ii, 821.—*A. Huegelii* Schott. Syn. 27; Prodr. 44.—*A. papillosum* Steud. ex Schott Prodr. (1860) 46; Hook. in Bot. Mag. t. 5496, excl. syn. *erubescens*.

Description: Cke. ii, 821.

Locality: Cooke mentions the W. Ghats and the S. M. Country between Ramghat and Belgaum. He has not seen any specimens. We doubt the occurrence of this species in the Presidency.

Distribution: Nilgiris, Travancore, Ceylon.

3. *Arisæma caudatum* Engl. in DC. Mon. Phan. ii, (1879) 559; Pflanzenr. iv, 23 F. (1920) 183; Hook. f. F.B.I. vi, (1893) 508; Cke. ii, 822.

This is a species only partly known. Hooker f. (F.B.I. vi, 508) had seen no specimen and described it from a drawing by Stocks who had seen the plant in

the Konkan.. Engler described the species, as he says himself, from a badly dried specimen. We reproduce Engler's description which is more complete than either Hooker's or Cooke's. It may help future botanists to identify the plant in the field.

Description: Leaf solitary. Dioecious (Hooker and Cooke speak of the spadix as androgynous). Petiole stout, narrowly sheathed; blade radiatisect; segments 7, oblong-elliptic, long and very narrowly acuminate, ending in an aristiform 1-1.5 cm. long tip, shortly cuneate at the base, 15-17 cm. long, the middle segment 5 cm. broad, the lateral ones narrower, lateral nerves archingly ascending at an acute angle, 7-9 mm. distant from each other, united into an intramarginal nerve 2-3 mm. inside the margin. Peduncle much shorter than the petiole. Tube of spathe long-infundibuliform, 6-7 cm. long, above 2 cm. diam., margin of the throat slightly recurved, blade erect, oblong-lanceolate, about 8 cm. long, 3 cm. broad below, contracted into a narrow linear tail 8 cm. long. Inflorescence of spadix about 5 cm. long; appendix stipitate, thickened at the base; only 1.5 cm. long.

This plant has not been observed since Stock's time.

4. *Arisæma longicaudatum* Blatter in Journ. As. Soc. Beng. (1930) 362 (*per errorem longicaudata*).

Description: Whole plant reaching 1 m. and more, as a rule dioecious. Tuber depressed-globose; root-fibres numerous, from the upper side of the tuber, less tough than in *A. Murrayi*. Leaf solitary, peltate; petiole stout, straight, up to 60 cm. long, cylindric, smooth, shining, green and purple-marbled; leaflets generally 6, whorled, petiolulate with petiolules 5 mm. long, very variable even in the same leaf, obovate-cuneate or broadly lanceolate or oblong-lanceolate, all caudate-acuminate, with acumination up to 4 cm. and capillary towards end, dark green above, paler beneath, shining, up to 22 cm. by 9 cm., intramarginal veins 2, nerves depressed above, prominent beneath. Peduncle up to 40 cm. cylindric, thinner than petiole, of the same colour, but green near top. Male spathe up to 30 cm. long, grass-green throughout, striped externally with white; tube elongate-cylindric, up to 8 cm. long, 2 cm. diam., widening into an ovate-lanceolate, long caudate-acuminate limb, 7 cm. long (without acumen) and 4 cm. broad, slightly reflexed near the tube, acumen 13 cm. long; limb deflexed, pendulous. Male spadix up to 9 cm. long, exerted from the tube for 1 cm., conical in the flower-bearing part which is about 5 cm. long, appendix about 4 cm. long, straight, slightly thickened at the base, then more or less uniformly cylindric, blunt at tip. Stamens white; filaments stout, about 2 mm. long, usually 3 united carrying 6, sometimes 7-8 anther-lobes which are shortly ovoid or globular. Female spathe up to 45 cm., tube 10 by 2.5 cm., limb (without acumen) 13 by 6 cm., acumen 22 cm. Female spadix: Flower-bearing part about 5.5 cm. long, above female flower some neuters for 5 mm., appendix 4 cm. long, like male. Female flowers arranged in many parallel dense spirals. Ovaries spherical or shortly oblong, green, unilocular. 1-3-ovuled; style very short, stout, green, stigma disk-like, white, covered with crystalline protuberances. Neuters above the female flowers up to about 17, subulate.

Here are a few measurements of a plant in fruit taken towards the end of August 1930 at Mahableshwar.

Leaflets (including tail) 43 cm. by 12.5 cm. Fruiting spadix up to 14 cm. long, 4.5 cm. diam. below, conical, some neuters persisting at top of cone. From the upper side of the tuber several young tubers arise. Tuber whitish green inside. Some fruiting specimens growing in rock-crevices at Panchgani had the petioles 1.2 m. in length, and peduncles 95 cm. long.

Abnormalities: In a female spadix (call it incipient or atavistic androgynous spadix) were noticed above the female flowers 2 male flowers, each consisting of 2 filaments united below and free above, each filament with 2 distinct white anther-lobes separated from each other by a broad green connective.

Mixed with the neuters of a female spadix the following were observed:

(a) One bisexual flower on 2 pedicels united at the base: one pedicel bearing an undeveloped ovary and well-developed style, the other pedicel one complete anther.

(b) Some male flowers: 1 filament with an anther-lobe.

(c) Some male flowers: 1 filament with a complete anther and connective.



1. *Cryptocoryne tortuosa*, Blatter & McCann, sp. nov.
(*In foreground near water*).



2. *Arisæma longicaudatum*, Blatter & McCann, sp. nov.
(*Photos by C. McCann.*)

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Flowers and leaves seen at the same time. Spathe usually reaching to up below the leaf, the leaf thus protecting the flower; the spathe is never higher than the leaf. The spathes turn pale and then yellow.

Locality: Mahableshwar, very common (Blatter P. 10!, P. 10a-e!, McCann!); Panchgani, very rare, only found in a few rock crevices (Blatter!, McCann!, May Langham!).

5. *Arisaema tortuosum* (Wall.) Schott Melet. i, (1832) 17; Hook. f. F.B.I. vi, (1893) 502; Cke. ii, 820.—*Arum tortuosum* Pl. As. Rar. ii, (1830) 10.

Description: Cke. ii, 820.

This is a most variable plant regarding the size, number and breadth of the segments. The inflorescence of the spadix may be monoecious or dioecious. The proportion of the male and female inflorescences, too, varies a good deal in the androgynous spadices. The length of the appendix and the colour of the spathe are not constant either.

Locality: Konkan (Stocks).—*W. Ghats*: Khandala (Chibber!).—*S. M. Country*: Tavargatti (Sedgwick 2632!, 2643!).—*N. Kanara*: Karwar (Talbot 514!, Bell 6107!).

Distribution: Chamba, Garhwal, Nepal, Sikkim, Khasia Hills, Burma, Central Provinces, Nilgiris.

Flowers: June 1883 (Karwar), June 1907 (Khandala), July (S. M. Country).

Fruit: Oct. (Karwar).

6. *Arisaema neglectum* Schott in Bonplandia vii, (1859) 26; Hook. f. F.B.I. vi, (1893) 504; Engler Pflanzenr. iv, 23 F. (1920) 192, fig. 43.—*A. filiforme* Thw. Enum. (1864) 334 (*non* Blume).—*A. Wightii* Bot. Mag. (1865) t. 5507 (*non* Schott).

Description: Leaves 2 or 1. Monoecious or dioecious. Tuber globose, young plants budding off from it. Cataphylls tubular below, above broadly linear, obtuse, obscurely spotted like the sheaths of the petioles, the uppermost about 15 cm. long. Petioles 20–40 cm. long, sheathed up to the middle or far beyond it; lamina 5- (sometimes 4-) to 7-radiatisect, segments elliptic or lanceolate-elliptic or lanceolate, shortly cuspidate-acuminate, cuneate at the base, sessile, with undulate margin, the intermediate one up to 10 cm. long or slightly longer, in the middle 4 cm. broad, the lateral ones slightly smaller, lateral nerves 5–7 mm. distant from each other and united into an intramarginal nerve 3–4 mm. away from the margin. Peduncle longer than the petioles, 30–40 cm.; tube of spathe pale green, cylindrical, 2–3 cm. long, throat slightly constricted with the margins subrevolute, lamina green, with lighter longitudinal stripes, ovate- or oblong-lanceolate, 5–6 cm. long, 2 cm. broad, long acuminate. Spadix of unisexual or androgynous inflorescence about 2 cm. long, green or dark purple, conical; appendix as thick below as the axis of the inflorescence, getting thinner upwards, sigmoidally curved. Male flowers subsessile, with 2–3 stamens; anther-lobes ovoid, dehiscing by a longitudinal slit.

Locality: Konkan: Hills N.-W. of Mulland, Salsette, in deciduous forests (McCann 1643!, 1644!, 1645!, 1646!, 1647!, 1648!, 1649!).—*N. Kanara* (Talbot 514!, 1258!).

Distribution: Konkan, N. Kanara, Nilgiris, Ceylon.

5. TYPHONIUM Schott (Cke. ii, 822).

Species 25.—Indo-Malayan.

Cooke mentions 2 species: *T. bulbiferum* and *T. cuspidatum*. We add *T. amboinense* and *T. trilobatum* and describe a new species. *T. cuspidatum* has to cede to *T. flagelliforme*.

I. Lower rudiments of sterile flowers clavate, upper ones subulate or only verruciform ...

1. Spathe more or less straight and upright ... 1. *T. flagelliforme*.

2. Spathe bent downwards above the tube ... 2. *T. incurvatum*.

II. Rudiments of sterile flowers never clavate.

1. Leaves bulbiferous at the apex of the petiole. 3. *T. bulbiferum*.

2. Leaves not bulbiferous ...

(a) Appendix of spadix red or red-fulvous, very shortly or scarcely stipitate ... 4. *T. trilobatum*.

(b) Appendix of spadix black-purple, longer stipitate ... 5. *T. amboinense*.

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1. *Typhonium flagelliforme* (Lodd.) Bl. in Wall. Cat. (1832) 8931; Engl. Pflanzenr. iv, 23 F. (1920) 112, fig. 16.—*Arum flagelliforme* Lodd. Bot. Cab. (1819) t. 396; Roxb. Fl. Ind. iii, (1832) 502; Wight. Ic. iii, (1843) t. 791.—*Heterostalis flagelliformis* Schott in Österr. bot. Wochenbl. vii, (1857) 261, Gen. Ar. (1859) t. 18.—*Arum cuspidatum* Bl. Cat. Gew. Buitenz. (1823) 101.—*Typhonium cuspidatum* (Bl.) Decaisne Herb. Timor in Ann. Hist. Nat. iii, (1834) 39; Bl. Rumphia i, (1835) 133. t. 30, f. 1-3; Hook. f. F.B.I. vi, (1893) 511; Cke. ii, 823.—*Nelenshena major* Rheede Hort. Mal. ii, (1679) t. 20.—*Arum angulatum* Griff. Notul. iii, (1831) 143.—*A. ptychiurum* Zipp. ex Kunth Enum. iii, (1841) 26.—*Typhonium hastiferum* Miq. Fl. Ind. Bat. iii, (1855) 194.—*T. Reinwardtianum* de Vriese et Miquel Fl. Ind. Bat. iii, (1855) 195.

Description: Cke. ii, 823.—A correction is necessary. Cooke says that the neuters above the male inflorescence are subulate. It should read below the male inflorescence, as there are no neuters above it.

Hook. f. (F.B.I. vi, 512) calls the spathe 'lurid red, papillose within.' Hallberg notes that in the plant from Parel the spathe was green and not papillose. Engler says that the tube of the spathe is green and the limb white.

We found the ovaries whitish (Cooke greenish), the lower neuters pale green with chocolate bifid tips (Cooke purple headed), the upper neuters whitish, the stamens yellow, the appendix of the spathe olive green or yellowish.

Locality: Konkan: Parel in Bombay Isl. (Ranade!, Cooke!, Hallberg!); Salsette (Hallberg!).

Distribution: Konkan, Travancore, Ceylon, Bengal, Burma, Malay Peninsula, Cochinchina, Laos, Cambodia, Tonkin, Java, Timor.

Flowers: Aug., Sept. 1892 (Parel).

2. *Typhonium incurvatum* Blatter & McCann, *sp. nov.* [Araceae].

Tuber globosus, vix depressus, 3 cm. diametens. Foliorum petioli tenues, canaliculati, ca. 20 cm. longi, basi equitantes; lamina viridis supra, pallidior infra et glauca, forma et magnitudine variabilis, sagittata vel hastato oblonga, a basi cordata et triloba, usque 10 cm. longa, medio 5 cm. lata, nervi depressi in facie superiore, prominentes in inferiore, lobi basales valde variabilis, absentes vel usque 2.5 cm. longi et 2 cm. lati. Pedunculus 3 mm. crassus, 7 cm. longus; spathae tubus viridis, ovoideus, superne profunde constrictus, 2 cm. longus; lamina dilute viridis, ovata, circa inflorescentiam masculam et appendicem sursum incurvata, transversaliter saccata, in flagellum 8 cm. longum et 4 mm. latum prolongata, apice acuta, a basi 5-nervosa, nervo centrali in apicem excurrente. Spadix ca. 5 cm. longa; inflorescentia feminea 6 mm. longa, cylindrica, alba, florum sterilius rudimenta claviformia apice depressa, purpurea, ca. 2 mm. longa, superiorum subuliformia, deflexa, albidia; feminea inflorescentia a mascula interstitio ca. 13 mm. longo separata; inflorescentia mascula cylindrica, 5 mm. longa, 2.5 mm. diametens, flava. Spadicis appendix brevissime stipitata, inferne constricta, elongato conoidea (minimem filiformis), 2.7 cm. longa, flavescens. Pistilla ovoidea, apiculata. Inflorescentia feminea in fructu elongato-ovoidea, cooperta spathae tubo permanente, quadrangularis. Pedunculus elongatus. Bacca oblongo-obovoidea, monosperma. Semen oblongum, aliquantulum latius in parte superiore, rugulosum, apice apiculatum.

Locality: Konkan: Sion in Bombay Isl., foot of W. slope of hill (McCann 998! type, 999! 1000!, 1001! co-types).

Flowers and Fruit: 25th Aug. 1929.

3. *Typhonium bulbiferum* Dalzell in Kew Journ. Bot. iv, (1852) 113; Hook. f. F.B.I. vi, (1893) 511; Cke. ii, 822; Engler Pflanzenr. iv, 23 F. (1920) 116, fig. 15 S-V.

Vern. name: Rantiri.

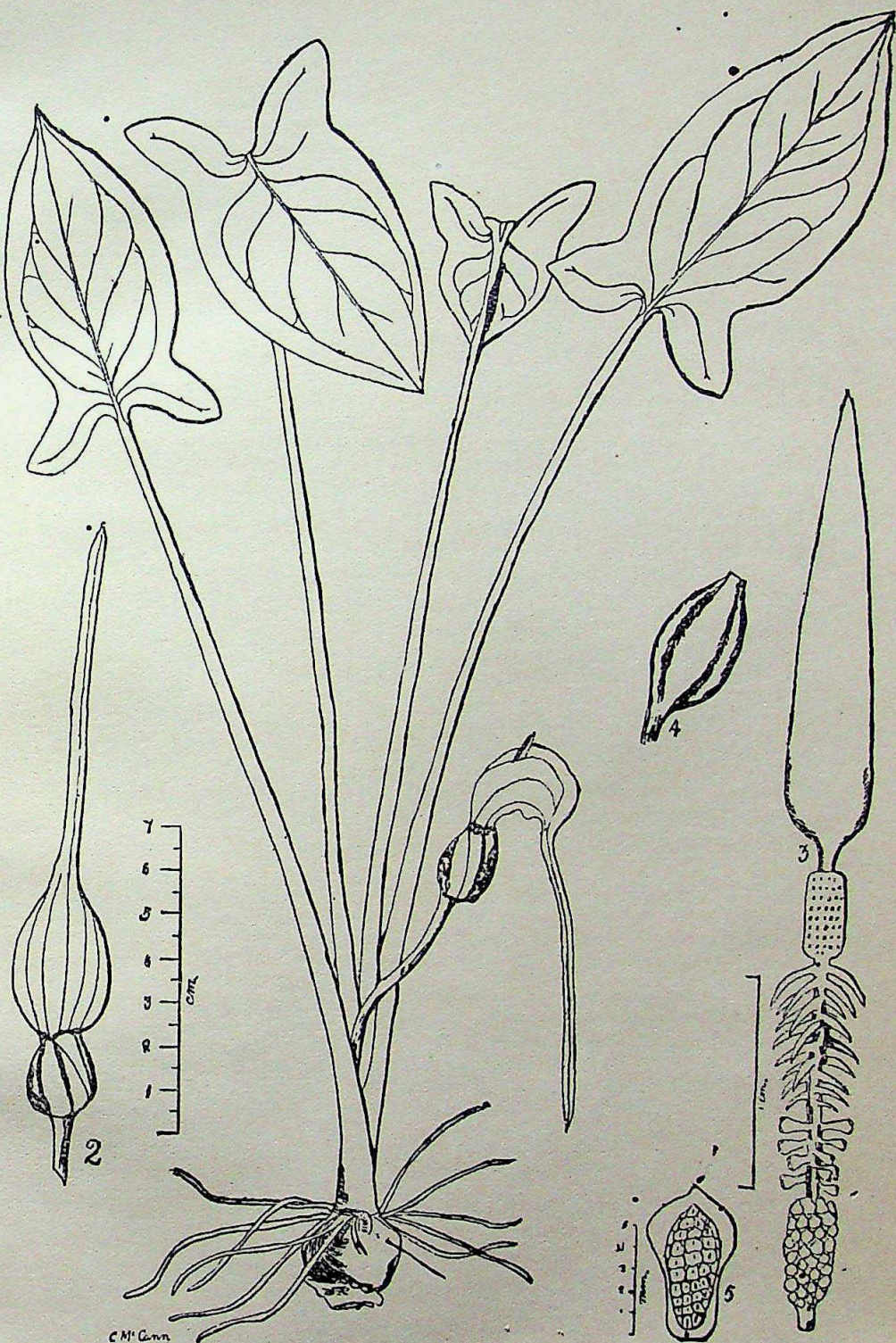
Description: Cke. ii, 822.

Locality: Konkan: (Stocks); Kalyan (Garade!); Roha (Damle 539!).—S. Konkan (Dalzell).—S. M. Country: Tavargatti, in shade of trees (Sedgwick 2618!).

Distribution: Apparently endemic.

Flowers: June 1902 (Roha); July 1905 (Kalyan); July 1917 (S.M. Country).

4. *Typhonium trilobatum* (Linn.) Schott in Wien. Zeitschr. iii, (1829) 72; Aroid. i, (1853) 12, t. 16.—For synonyms, see Hook. f. F.B.I. vi, 509.



C. M. Cann

Typhonium incurvatum, Blatter & McCann, sp. nov.

1. Plant. 2. Spathe. 3. Spadix. 4. Fruit. 5. Bacca.

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Description : Tuber subglobose, up to 4 cm. diam. Petioles 25-30 cm. long, often surrounded by a variegated sheath, pale green, irregularly mottled with purple; lamina hastate-subtriset, segments all acuminate, front-segment ovate, 8-18 cm. long, 5-10 cm. broad, lateral ones obliquely ovate, shorter, sub-bilobed at base. Peduncle thin, 5-7 cm. long; tube of spathe oblong, 2.5 cm. long, 1-1.5 cm. wide, lamina oblong-ovate-lanceolate, acuminate, 15 and more cm. long, 5-7 cm. broad, outside pale green, inside rose-purple. Spadix nearly 15 cm. long. Female inflorescence short-cylindric, about 7 mm. long; rudiments of sterile flowers filiform, flexuose, almost 1 cm. long, occupying a space of about 7 mm. long immediately above the female flowers. Male inflorescence about 1.25-1.5 cm. long, 5 mm. diam., rose-pink, separated from the female inflorescence by an interval of about 2 cm. Appendix very shortly stipitate, broad at the base, 4-7 mm. diam., elongate-conical, about 5-12 cm. long.

Locality : Bombay Pres. (Graham).

Distribution : W. Peninsula, Ceylon, Bengal, Burma, Assam, Chittagong, Malay Peninsula, Siam, Cambodia, Tonkin, Java, Borneo.

5. *Typhonium amboinense* Blatter & McCaun, nov. comb.—*Arisarum amboinense* Rumph. Herb. Amb. v, (1747) 320, t. 110, f. 2.—*Arum Roxburghii* Thwait. Enum. Pl. Zeyl. (1864) 432.—*Typhonium Roxburghii* Schott Aroid. i, (1855) 12 (excl. t. 17); Saunders Ref. Bot. (1871) t. 283; Hook. f. F.B.I. vi, (1893) 510; Engl. Pflanzenr. iv, 23 F. (1920) 119, fig. 17, C. D.—*Arum trilobatum* Roxb. Fl. Ind. iii, (1832) 505; Wight Ic. iii, (1843) t. 803; Bot. Mag. t. 339.—*Typhonium javanicum* Miq. Fl. Ind. Bat. iii, (1855) 193.—*T. divaricatum* γ et δ. Engl in DC. Mon. Phan. ii, (1879) 612.

Description : Tuber subglobose. Petioles thin, 10-35 cm. long, lamina hastate-3-lobed or hastate-subtriset, segments shortly acuminate, middle segment ovate, 5-9 cm. long, 3-4 cm. broad, lateral ones obliquely ovate or obliquely oblong-ovate, sometimes lobed-dilatate on the outer side below. Peduncle thin, 2-9 cm. long; tube of spathe oblong, 2 cm. long, 1 cm. wide, lamina ovate-lanceolate, acuminate, up to 15 cm. long, below 5 cm. broad, outside pale, inside dark purple-violet. Female inflorescence of spadix shortly cylindric, about 4 mm. long; rudiments, of sterile flowers filiform, flexuose, about 5-6 mm. long, deflexed, occupying 5 mm. immediately above the female inflorescence, about 1 cm. long, 5 mm. wide, separated from the female inflorescence by an interval of 1.2-1.5 cm. Appendix of spadix thinly stipitate, at the base 3-4 mm. diam., elongate-myosuroid, 10-12 cm. long. Stamens 2-3. Pistils obovoid; stigma sessile.

Locality : Konkan : Bombay Isl., coconut groves at Dadar, especially in sandy soil (Blatter!).—W. Ghats : Panchgani, in rock crevices (McCann 2781!).

Distribution : Ceylon, Konkan, W. Ghats, Malay Peninsula, Borneo, Philippines, Java.

Flowers : July (Bombay).

Species dubia.

Graham [Cat. Bomb. Pl. (1839) 228] mentions *Arum divaricatum* Linn., which had been included by Roxburgh in his Fl. Ind. iii, (1832) 503. But there is a difficulty about the identity of *A. divaricatum* Linn. Linné [Sp. Pl. (1753) 967] refers under *A. divaricatum* to the Fl. Zeyl. no. 325. As, however *Typhonium divaricatum* (Linn.) Decaisne has not been found in Ceylon, Trimen (Handb. Fl. Ceyl. iv, 354) suspects that *A. divaricatum* Linn. belongs either to *Typhonium Roxburghii* (our *T. amboinense*) or to *T. cuspidatum* (now *T. flagelliforme*). As there are no original specimens in Hermann's herbarium, it is impossible to say what Linné's *A. divaricatum* really is.

6. THERIOPHONUM Blume (Cke. ii, 823).

Species 6.—Indian.

Cooke has one species: *T. Dalzellii* Schott. We add *T. minutum* Engl. and describe a new one. *T. Dalzellii* has to be changed into *T. indicum* Engl.

A. Lower and upper rudiments of sterile flowers
near the male flowers

1. *T. minutum*.

B. Lower rudiments of sterile flowers near the female flowers

- | | | | |
|--------------------------|-----|-----|----------------------------|
| I. Pistils sub-4-seriate | ... | ... | 2. <i>T. indicum</i> . |
| II. Pistils uniseriate | ... | ... | 3. <i>T. uniseriatum</i> . |

1. *Theriophonum minutum* (Willd.) Engl. Pflanzenr. iv, 23 F. (1920)* 105.—*Arum minutum* Willd. Sp. Pl. iv, (1805) 484; Graham Cat. Bomb. Pl. (1839) 228.

Description: Tuber small, depressed, 1–2 cm. diam. Petioles 5–15 cm. long, narrowly sheathed up to the middle or beyond and pale rose coloured or fusco-punctate, above the sheath green; lamina hastate-triangular, subtrilobous, with the margin undulate, about 3–5 cm. long, front-lobe twice as long as the lateral ones, 2–5 cm. broad, all lobes sub-obtuse or shortly acuminate. Peduncle 3–10 cm. long; spathe whitish; tube about 1–2 cm. long, obtuse at the base or subtruncate; lamina oblong, subacute or shortly cuspidate, about 7–9 cm. long, 3–3.5 cm. broad, red, with the margin crisped-crenulate. Female inflorescence few-flowered; pistils subbiseriate; male inflorescence thinly cylindrical, 1–1.5 cm. long, separated from the female inflorescence by a naked interval of 2–4 mm. Rudiments of sterile flowers thin, subulate, 2–4 mm. long, occupying about 4 mm. at the base of the male inflorescence, others shorter, 1–2 mm. long, occupying 5–8 mm. above the male inflorescence, lilac like the male flowers. Appendix subcylindrical, about 1.5–3.5 cm. long, stouter below (3–4 mm. diam.), above slightly thinner, obtuse, black purple.

Var. Heynei, Engl. in DC. Mon. Phan. ii, (1879) 607; Pflanzenr. iv, 23 F. (1920) 105, fig. 2, R and 15 A. F.—*Arum crenatum* Wight in Hook. Bot. Misc. ii, (1831) 100; Suppl. t. 3; Graham Cat. Bomb. Pl. (1839) 228.—*Typhonium crenatum* Schott Melet. i, (1832) 17.—*Theriophonum crenatum* Bl. in Rumphia i, (1835) 128; Schott Aroid. i, (1853) 15, t. 21; N. E. Brown in Journ. Linn. Soc. xviii, (1880) 259. *excl. syn.* *T. Kleinii* Schott; Hook. f. F.B.I. vi, (1893) 512 *excl. syn.* *T. Kleinii*.

Description: A taller plant. Petioles up to 15 cm. long; lamina about 5 cm. long. Tube of spathe subtruncate at the base, up to 2 cm. long; lamina oblong, about 9 cm. long. Lower rudiments of sterile flowers forming a spike as long as the female inflorescence, the upper rudiments together with the fertile male flowers forming a spike as long as the female inflorescence. Connective of stamen shortly rostrate.

Locality: Bombay Pres. (Graham).

Distribution: Madras, Coromandel coast.

Var. Kleinii, Engl. in DC. Mon. Phan. ii, (1879) 607.—*Arum minutum* Willd. Sp. Pl. iv, (1805) 484; Grah. Cat. Bomb. Pl. (1839) 228.—*Typhonium minutum* Bl. in Rumphia i, (1835) 134.—*Theriophonum Kleinii* Schott in Oesterr. bot. Zeitschr. viii, (1858) 3.—*T. crenatum* Schott Aroid. i, (1855) 15, t. 21.—*Nelenschena minor* Rheede Hort. Malab. xi, (1692) 33, t. 17.

Description: A smaller plant. Petioles 5 cm. long; lamina about 4 cm. long. Tube of spathe ovate, about 1 cm. long; lamina about 7 cm. long. Lower rudiments of sterile flowers forming a spike shorter than the female inflorescence, the upper rudiments together with the fertile male flower forming a spike about 6 times as long as the female inflorescence. Connective of stamens shortly rostrate.

Locality: Bombay Pres. (Graham).

Distribution: W. Peninsula of India. No definite locality.

2. *Theriophonum indicum*, (Dalz.) Engl. in Pflanzenr. iv, 23 F. (1920) 107.—*Tapinocarpus indicus* Dalz. in Hook. Journ. Bot. iii, (1851) 316.—*Theriophonum Dalzellii* Schott Aroid. i, (1853) 15, Syn. (1856) 21; Engl. in DC. Monogr. Phan. ii, (1879) 608; Hook. f. F.B.I. vi, (1893) 513; Cke. ii, 823.—*Tapinocarpus Dalzellii* Schott. Gen. Ar. (1859) t. 15.

Description: Tuber about 2 cm. diam. Leaves appearing with the flowers or a little in advance of them. Petiole 20–25 cm. long, vaginate for the third or fourth part of its length; lamina up to 20 cm. long, variable in breadth, elliptic, oblong or linear, acute or subobtuse, smooth and shining above, dull beneath, base rounded or hastate, or sagittate, front-lobe ovate-oblong to oblong, 4–5 cm. broad, lateral lobes oblong, usually only 3 leaves. Peduncle up to 20 cm. long, in fruit twisted and curved to the ground. Tube of spathe

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subtruncate at the base, oblong, green when young, soon fading to white, 3 cm. long, 1.5 cm. wide; lamina lanceolate-oblong, long-acuminate, deep purple, rapidly fading, 15 cm. long, 2.5 cm. broad. Female inflorescence short, pistils sub-4 seriate, separated from the male inflorescence by an interval of 2.3-3 cm.; male inflorescence about 7 mm. long; rudiments of sterile flowers near the pistils, thinly subulate, about 4 mm. long, greenish yellow, a few short subulate rudiments above the male inflorescence and close to it. Anthers rosy purple. Ovaries whitish, with greenish yellow hairs on top, stigma purple-pink. Appendix of spadix deep crimson or purple, when young greenish yellow above, thinly cylindrical, about 15 cm. long, 1.5 mm. thick. Ovules 4-6, of which 1-3 are pendulous from the top of the cell of the ovary, the remaining ones basal, erect. Fruit angular, 4-5-seeded.

According to McCann the young leaves are entire, cordate, ovate or almost round, acuminate.—The tuber produces a number of young tubers from the upper side.

Locality: Konkan (Stocks, Dalzell); Vengurla (Dalzell); moist grassy places in S. Konkan (Dalzell and Gibson); Kalyan (Woodrow!); hill N.-W. of Bhandup, under shrubs and in open along aqueduct (McCann 694!, 695!); Bhandup (Blatter and McCann 26381!, 26384!).—*N. Kanara*: Karwar (Talbot 85!, 1890!).

Distribution: Apparently endemic.

Flowers: June 1917, July 1929 (Bhandup); June 1883, Aug. 1899 (Karwar).

3. *Theriophonum uniseriatum*, Blatter & McCann, *sp. nov.* [*Aracea, accedens ad T. indicum* Engl., a quo tamen differt pistillis uniseriatis, florum sterilium rudimentis 1 cm. ab inflorescentia feminea remotis, aliis rudimentis absentibus, inflorescentia mascula multo longiore].

Tuber circa 2 cm. diametens. Folia cum floribus coelanea. Foliorum petiolus usque 25 cm. longus. Lamina usque 16 cm. longa et 15 cm. lata ubi latissima, late ovata et irregulariter hastata vel oblongo-cordata. Pedunculus crassus, usque 13 cm. longus. Spatha usque 20 cm. longa; tubus pallide viridis quando juvenis, basi convolutus; lamina oblongo-lanceolata, intus nigro-purpurea, extus olivacea. Spadicis inflorescentia feminea brevis, ca. 5 mm. longa, obovoidea, pallide viridis; pistilla uniseriata; stigma latum pilis minutis crystallinis coopertum. Florum sterilium rudimenta plura 1 cm. ab inflorescentia feminea remota, tenuiter subulata, erecta vel ascendente, 3-4 mm. longa, flavo-brunnea, alia rudimenta nulla. Inflorescentia mascula 2 cm. altius in spadice posita, 12 mm. longa; antherae roseo-purpurascens, thecis poro apicali aperientibus. Axis inter flores femineos et steriles rubro-purpurea inter steriles et masculas nigro-purpurea. Appendix teres, elongata, non stipitata, versus apicem attenuata, 8 cm. longa, basi 3 mm. diametens, flava quamdiu inclusa in spatha, deinde purpurea.

Locality: *N. Kanara*: Karwar (T. R. D. Bell 1666!).

Flowers: End of July 1924.

7. SAUROMATUM Schott (Cke. ii, 824).

Species 4.—Palaeotropics.

1. *Sauromatum guttatum* (Wall.) Schott Melet. i, (1832) 17; Hook. f. F.B.I. vi, (1893) 508 emend.; Cke. ii, 824; Engl. Pflanzenr. iv, 23 F (1920) 123, fig. 18 A-L.—*Arum guttatum* Wall. Pl. As. Rar. ii, (1831) 10, t. 115.—*Sauromatum simlense* Schott in Osterr. bot. Zeitschr. viii, (1858) 263.—For further synonyms see Hook. f. l.c.

Description: Tuber very large, globose, up to 15 cm. diam., producing buds from the top and sides. Leaf solitary. Petiole up to 50 cm. long, very stout at the base, up to 2 cm. diam., attenuate upwards, spotted or not; lamina in outline rotund-cordate, pedate-palmate to pedatifid or pedatisect; segments oblong or oblong-lanceolate, acuminate, the intermediate one up to 25 cm. long, 15 cm. broad, the lateral ones on each side 3-7, getting gradually smaller; primary lateral nerves about 5-6 on each side, distant from each other 1-1.5 cm., and secondary parallel nerves united into an intramarginal nerve 2-3 mm. from the margin. Peduncle measuring scarcely 5 cm. beyond the cataphylls and 2 cm. diam., pale green, cataphylls few, soon withering, 5-10 mm. long, triangular, acute, broad at base. Spathe large, very variable in size; tube 5-10 cm. long, slightly ventricose below, above subcylindric, about

2-2.5 cm. ~~the~~ lamina in aestivation convolute into a purple-livid cylinder which is tumid at the base, then straight-ascending and slender acuminate, when expanded oblong-lanceolate, very large, 30-70 cm. long, 8-10 cm. broad, lower margin irregularly sinuate-repand, upwards gradually narrowed into an acumen, purple below, light green in the middle and above, often with angular dark purple spots or blotches, finally recurved from the middle, descending and touching the ground. Spadix about $\frac{1}{3}$ shorter than the spathe. Female inflorescence cylindric, about 2-2.5 cm. long, 1.5 cm. diam.; rudiments of sterile flowers stipitate-claviform, spreading, inserted immediately above the female flowers; male inflorescence 1.5 cm. long, distant from the female inflorescence by an interval of about 6 cm. which bears some scattered minute, acute, aculeiform rudiments; appendix cylindric, obtuse, about 30 cm. long, 1 cm. diam., pale fuscous or purplish. Pistils very numerous, small, obovoid, subtruncate at top, 2-ovulate. Stamens with very short filaments.

Note: Sometimes only the central leaflet develops.

Hallberg found a specimen at Bandra (July 1917) with two quite green leaves, one sheathed by the other. The inner one was the larger and showed a central channel in which there was a thick laminar outgrowth, probably the remains of the free basal margin of the leaf. Inside the channel there was a leaf-embryo with a thick conical petiole and a minute bifid lamina which was decomposing. The whole may have been due to the leafing of the peduncle, the second leaf being the spathe and the third a carpel.

For some biological notes on this species and a good illustration of the leaf we refer to C. McCann in this Journal, vol. xxxiv, (1930) 518, fig. 1.

Locality: Gujarat: Surat (Herb. R. E. P. Calcutta 20,332).—*Konkan*: (Stocks); Versova (Blatter & McCann 26373!); Thana Dist. (Ryan); Bhandup (Blatter & McCann 26383!); Sion Hill (McCann 995!); Uran (Hallberg and McCann!); Salsette (McCann!). *Deccan*: Junnar (Paranjpye!).—*W. Ghats*: Panchgani (Blatter P 22!); Lonavla (Woodrow!); Khandala (Blatter & McCann!). *S. M. Country*: Astoli (Sedgwick 2524!).

Distribution: Punjab, Gangetic Plain, Himalaya from Simla to Nepal, Chota Nagpur, Gujarat, Konkan, Deccan, W. Ghats, Burma, Sumatra.

Flowers: Jan. 1917 (Uran); March 1911 (Junnar, Thana, Bhandup); June 1917 (Bhandup, Panchgani); July 1925 (Panchgani).

Fruit: Sept. 1917 (Versova).

8. AMORPHOPHALLUS Blume (Cke. ii, 825).

Species about 90. Tropical Asia and Africa.

Cooke gives 3 species: *A. bulbifer*, *A. campanulatus*, and *A. commutatus*. We add *A. silvaticus* and *A. Hohenackeri*.

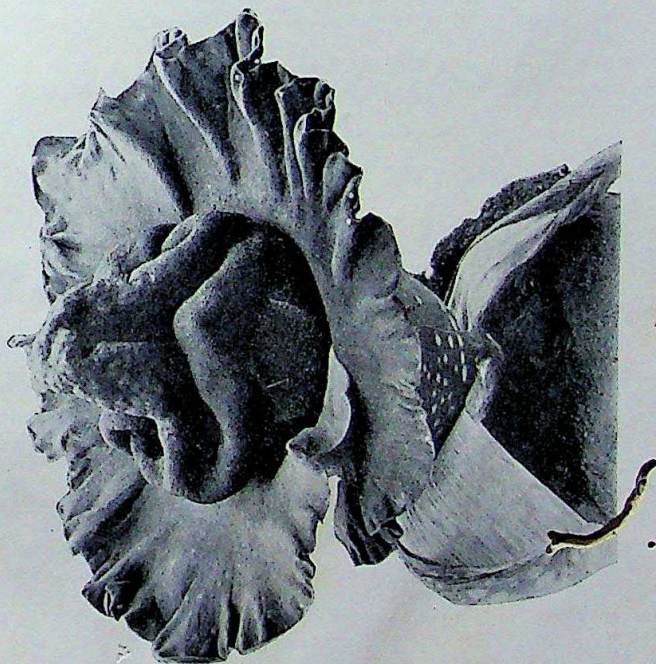
A. Leaves not bulbiferous

- | | |
|---|-----------------------------|
| I. Spathe greenish pink, 15-25 cm. broad; appendix irregularly amorphous, dark purple | 1. <i>A. campanulatus</i> . |
| II. Spathe brownish purple, 5-10 cm. broad, appendix terete, smooth, cream-coloured | 2. <i>A. commutatus</i> . |
| III. Spathe white inside, outside green, white-striate, towards the margin white-spotted, 3 cm. broad; appendix elongate-conical, pale straw-coloured, flexuose | 4. <i>A. silvaticus</i> . |
| IV. Spathe 3 cm. broad; appendix 3.5-4 cm. long, 1.5 mm. diam., elongate, thin, subulate, straight | 5. <i>A. Hohenackeri</i> . |
| B. Leaves bulbiferous | 3. <i>A. bulbifer</i> . |

PLATES V & VI.

1. *Amorphophallus campanulatus*, (Roxb.) Bl. in Decne in Nouv. Ann. Mus. Par. iii. (1834) 366 *excl. syn. praeter* Roxb.; Cke. ii, 825; Engler Pflanzenr. iv. 23C (1920) 76. For synonyms see Hook. f. F.B.I. vi, (1894) 513.

Description: Cke ii, 825. A more complete description by Khadilker in Journ. Ind. Bot. ii, (1921) 55.



1. Open flower of *Amorphophallus campanulatus*, Blume.

(4 days later than Pl. VI, 1).

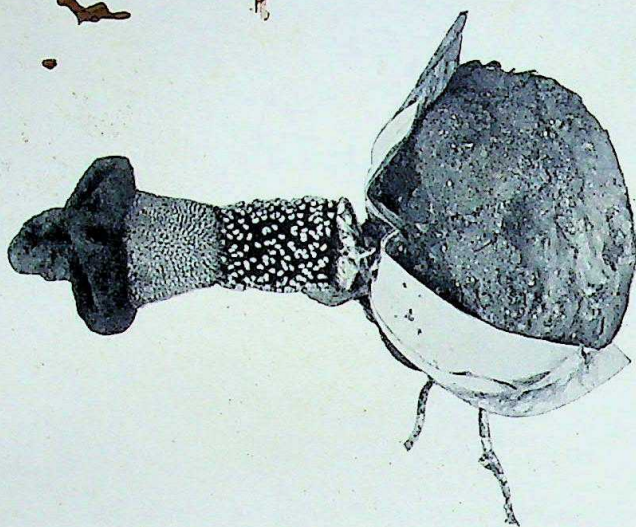


2. Open flower of *Amorphophallus campanulatus*, Blume.

(Photos by C. McCann.)



1. Bud of *Amorphophallus campanulatus*, Blume.



2. Spadix of *Amorphophallus campanulatus*, Blume.

(Photos by C. McCann.)

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For biological notes see McCann in this Journal, vol. xxxiv, (1930), 520.
Cataphylls usually 2, greenish, obovate, tip emarginate, apiculate, about 13 cm. long.

The bad smell is restricted to the appendix of the spadix (McCann).

Appendix of spadix crimson lake when fresh, turning purple and eventually brown. Colour of spathe very variable, but usually has large whitish blotches.

Locality: Konkan: Borivli to Kanari Caves (McCann 1638!); Jogeshwari in Salsette (McCann!); common throughout Salsette (McCann). *S.M. Country*: Londa (Sedgwick 2538!). Cultivated in gardens in Gujarat, Bombay and Deccan.

Distribution: Tropical Himalaya, plains from the Punjab to Bengal and down to Ceylon, Assam, Burma, Andamans, Malay Peninsula, Siam, Malaya, New Guinea, Melanesia.

Flowers: May 1917 (Londa); 15th June 1930 (Kanari Caves); June 1930, July 1928 (Jogeshwari); leafed in 1829.

2. *Amorphophallus commutatus*, Engl. in DC. Mon. Phan. ii, (1879) 319; Cke. ii, 826. *Conophallus commutatus* Schott in Bonpl. (1859) 28.

Description: Cke. ii, 826. See also Lisboa in this Journal x, (1896) 527.

For biological notes see McCann in this Journal xxxiv, (1930) 520.

The following abnormalities were observed by Hallberg in specimens from Mulgaum, Salsette: Leafy carpels, a pedunculate spadix, appendix branched at base and on the same plant a number of cream tubercles amongst the green ovaries. McCann found a specimen with the appendix branched at the tip.

Locality: Konkan: (Stocks, Graham),; Ambenali (McCann!) Borivli to Kanari Caves (McCann 1244!, 1641!, 1642!); hills N.-W. of Bhandup (McCann 707!, 708!, 709!, 710!, 711!); Bhandup (Blatter 26382!); in forest near foot of Kanari Caves (McCann 616!, 617!); foot of hills W. of Mullan (McCann 878!); Vikroli (McCann!); S. Konkan (Dalzell and Gibson); Bombay (Hallberg!); Kurla (Gammie 15118 bis!); Marmagao (Woodrow!); Bassein (Ryan 1687!); Savantvadi (Dalgado) — *W. Ghats*: From Bombay to Kumpta (Lisboa!); Matheran (Cooke!); Khandala (McCann!). — *Deccan*: Ganeshkhind Bot. Garden (Paranjpe!); Poona (Herb. Calc.). — *S. M. Country*: Astoli (Sedgwick 2615!); Sakharpa, Kolhapur Ratnagiri Road (Bhide!); Belgaum (J. H. Burkill). — *N. Kanara*: Karwar (Bell 6140 bis!); in forests (Bell 6176!); Bellkerry (Talbot 492! in Herb. Sedgwick).

(The last mentioned sheet bears the name *Raphiophallus Hohenackeri* Schott. This is a synonym of *Amorphophallus Hohenackeri* Engl. The specimen however is evidently *A. commutatus*.)

Engler mentions the same number by Talbot in the Calcutta Herbarium under *A. Hohenackeri*. It is quite possible that two different species were distributed under the same name).

Distribution: Apparently endemic in the Bombay Pres.

Flowers: April 1901 (Savantvadi); May 1908 (Ganeshkhind, Matheran); June 1883 (N. Kanara); June 1919 (Karwar); June 1917 (Bhandup); June 1930 (Borivli to Kanari Caves); June 1929 (Foot of Kanari Caves); July 1928 (Vikroli); July 1929 (Bhandup).

Fruit: June 1917 (Bhandup); Aug. 1929 (N.-W. of Mullan); Sept. 1903 (Bassein); Oct. (Ambenali); Nov. 1902 (Belgaum).

Uses: The unopened inflorescence is eaten as a vegetable.

3. *Amorphophallus bulbifer*, (Roxb.) Bl. in Rumphia i, (1835) 148; Cke. ii, 825. — *Arum bulbiferum* Roxb. Fl. Ind. iii, (1832) 510; Bot. Mag. t. 2072, 2508; Engl. Pflanzenr. iv, 23 C (1911) 98. — *Pythonium bulbiferum* Schott Melet. (1832) 18.

Description: Tuber about 5-8 cm. diam., subglobose. Petioles up to 1 m. long, 1.5-3 cm. diam., smooth, dirty or olivaceous green, with pale irregular or linear spots; lamina 3-sect, bulbiferous at the branching, the ribs and nerves; primary lateral segments 20-30 cm. long, dichotomous, secondary segments pinnatisect, rarely bipinnatisect, few-jugate, lower segments 4-6 cm. long, 3-4 cm. broad, ovate, upper ones 10-12 cm. long, 6-7 cm. broad, oblong-lanceolate, all long-acuminate. Peduncle 20-30 cm. long, 1-1.5 cm. thick, nearly quite cylindrical all the way up, quite smooth, dark olive green with numerous narrowly oblong, sometimes crowded greyish blotches throughout its length, these blotches having a pinkish shade below in fresh specimens and a greenish shade towards the top of the peduncle, being about 2 cm. in length,

sometime coarcescent, sometimes, especially upwards, shorter and roundish, all of them with irregular edges. Spathe 10-12 cm. long, 10 cm. broad when expanded, sessile, long-conical before opening, with a small apiculus at top, longitudinally many-veined, the veins towards the margins wider apart and net-veined between, delicate olive green, very light in shade, with many roundish nearly white blotches throughout which are not large, often coalescing and with a pinkish shade towards the base in fresh specimens; inside the spathe is a very delicate shell pink at the base, and in the middle gradually passing into the light olive green of the outside upwards and towards the margins; the veins in the green part always thinly darker. Spadix slightly shorter than the space, about 12 cm. long, shortly stalked, (about 12 mm.), the stalk very delicate dull olive green with somewhat obscure, round, whitish blotches, followed by 5 or 6 rows of female flowers, occupying a space of 1.5-2 by 1.5 cm.; the rows not regular, the lower flowers more developed and more separated from each other than those towards the top which are crowded together forming a mass of stigmata, the former squat pear-shaped, deep red in colour, surmounted by the shortly and thickly stalked stigmata which lean upwards, are circular-convex or nearly disk-shaped, the surface often being uneven; stigma yellow when fresh and still in the spathe, changing to green later on. The male flowers follow immediately after the females without an interval of any kind and are crowded together, occupying a space of 2.5 by 1.5 cm., very delicately shell pink like the inside of the spathe; anthers sessile, generally 5-sided from being so crowded, otherwise globose where free (1 or 2 towards the base), free, with 2 parallel impressed pores on their upper surface. Appendix 5-8 cm. long, 2-2.5 cm. diam., conical, the thickest part about 20 mm. above the base, extreme base about 18 mm. diam., the tip very bluntly rounded, about 8 mm. diam., colour a smooth silky white with a pink tinge, the surface dull but not at all uneven.

For morphological and biological notes see McCann in this Journal xxxiv, (1930) 519.

Localities: Konkan: Ambenali (McCann!); Borivli to Kanari Caves (McCann 1255!, 1252!); hills W. of Mullan (McCann 883!, 884!); hills near Ghorbunder, Salsette (McCann!).—*S. M. Country*: Devarayi (Sedgwick 4124!, 4041!).—*N. Kanara*: Forests (Bell 6108!); Yellapur (Bell 6080!); Pattanpar (Bell!).

Distribution: Chota Nagpur, Bengal, Sikkim, Khasia Hills, Assam, Burma.

Flowers: June 1915 (Pattanpar); June 1918 (S. M. Country); June 1919 (Yellapur).

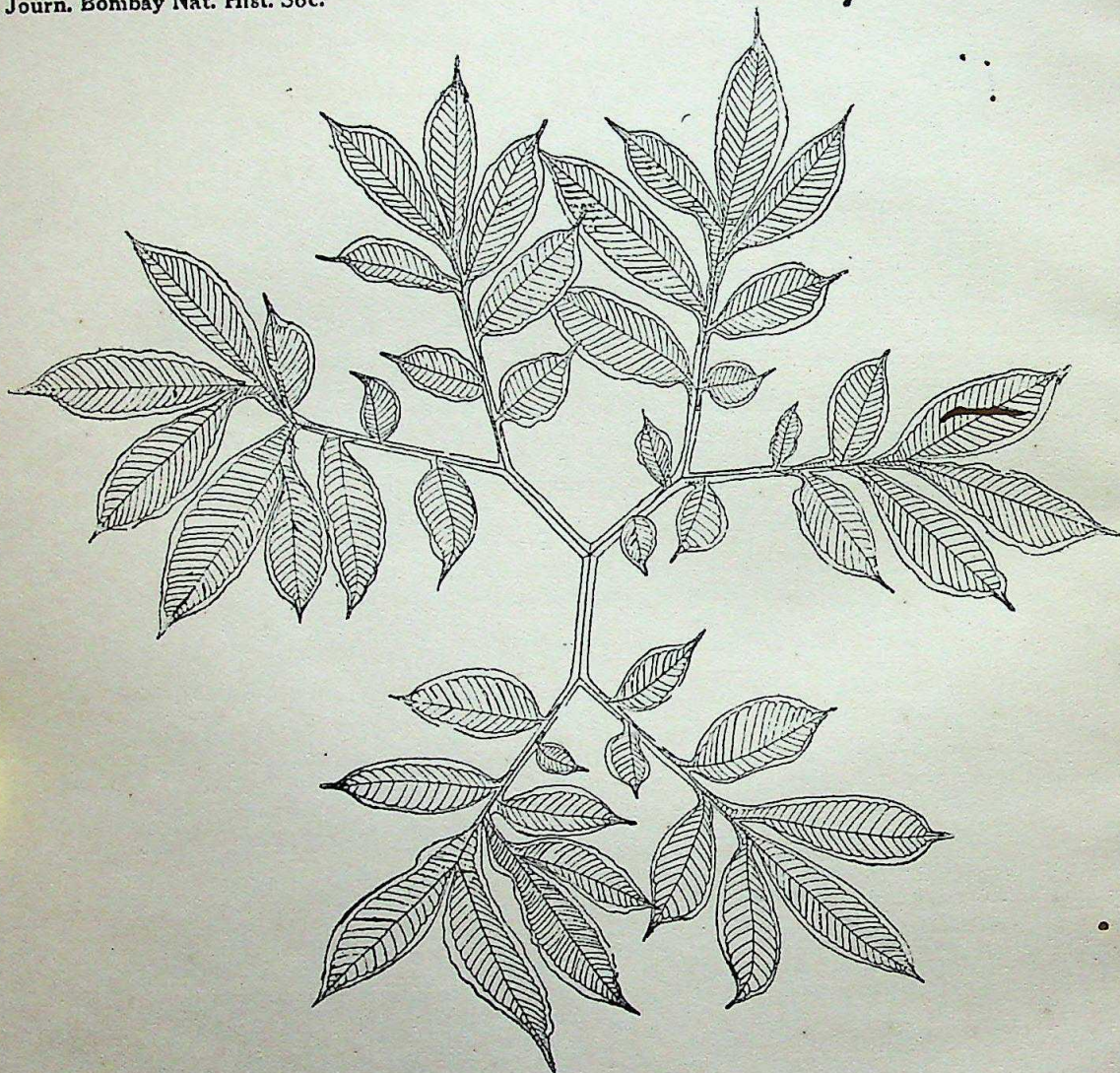
Fruit: 15th Sept. 1929 (Kanari Caves); Oct. 1930 (Ambenali).

4. *Amorphophallus silvaticus*, (Roxb.) Kunth Enum. iii, (1841) 34; Engler Pflanzenr. iv, 23C (1911) 103, fig. 35 A-E. *Arun silvaticum* Roxb. Fl. Ind. iii, (1832) 511; Wight Ic. t. 802. *Synantherias silvatica* Schott Gen. Ar. (1858) t. 28; Hook. f. Bot. Mag. t. 7190 et F.B.I. vi, (1893) 518. *Amorphophallus zeylanicus* Bl. in Rumphia i, (1835) 148.—*Brachyspatha zeylanica* Schott Syn. (1856) 36.

Description: Tuber 5-6 cm. diam., slightly depressed. Petioles long, smooth, green; lamina 3-sect, primary lateral segments dichotomous, secondary ones pinnatisect, tertiary ones lanceolate or obovate, acuminate, decurrent with the exception of the lowest. Peduncle about 20-25 cm. long, 1 cm. diam. Spathe about 5 cm. long, 3 cm. broad, erect, ovate, in the middle convolute, inside white, greenish at the apex, outside green, white striate, towards the margin white-spotted. Spadix stipitate, up to 3 times as long as the spathe. Female inflorescence 1.5 cm. long, interval bearing the neuter flowers 1.5 cm. long; male inflorescence 2-2.5 cm. long, 4 mm. diam., appendix 10-15 cm. long, 5 mm. thick below, elongate-conical, flexuose, above the inflorescence slightly thickened, longitudinally sulcate, pale straw-colour. Stamens short or disposed round a naked disk, or irregularly scattered; anthers subsessile, the thin connective slightly raised above the lobes. Neuters uniseriate, oblong, depressed, rugose. Ovary 1.5 mm. long, globose, 2-locular, loculi 1-ovuled, ovule attached to the middle of the dissepiment; style 0.5 mm. long; stigma slightly 3-lobed.

Locality: N. Kanara: Bedoli (Herb. Econ. Bot. Poona 1!).

Cooke (ii, 829) excludes this species, because Engler gives Bombay as locality of a specimen which in reality refers to a plant originating from the Nilgiris and Coorg. In the meantime a specimen has been gathered in N. Kanara.



Del C. McCann.

Leaf of *Amorphophallus commutatus*, Engl.

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Distribution : N. Kanara, Nilgiris, Malabar, Circars, Ceylon in dry regions.

Flowers : Sept. 1893.

5. *Amorphophallus Hohenackeri*, (Schott) Engl. and Gehrm. in Engler Pflanzenr. iv, 23C (1911) 103, fig. 35, f-m.—*Raphiophallus Hohenackeri* Schott Gen. Ar. (1858) t. 27.—*Hydrosme Hohenackeri* Engl. in Engl. and Prantl Pflanzenf. ii, 3 (1837) 128 *ibid.* Nachtr. i, (1897) 59.

Description : Tuber 2-3 cm. diam. Petiole 20-30 cm. long, 2 cm. diam., lamina 3-sect; primary segments 10-15 cm. long, dichotomous, secondary segments scarcely 10 cm. long, pinnatisect, tertiary segments 2-6 cm. long, 1.5-3 cm. broad, oblong, acute, cuneately decurrent, lateral nerves numerous, parallel, spreading, united into an intramarginal nerve not far removed from the margin. Peduncle scarcely 30 cm. long, thin. Spathe about 8 cm. long, 3 cm. broad, tube convolute, open above; lamina erect, lanceolate, acute. Spadix short-stipitate, slightly shorter than the spathe, or as long; female inflorescence 1.5 cm. long; neuters gibbous, occupying the 5 mm. long space between the female and male inflorescences; male inflorescence 1 cm. long. Appendix 3.5-4 cm. long, 1.5 mm. thick, elongate, thin, subulate. Anther-lobes obovoid, with 2 confluent pores at the apex forming a transverse small slit. Pistil obpyramidal-tetragonous, 3-locular; stigma sessile, broad, discoid, slightly 3-4-lobed.

Locality : N. Kanara (Talbot 492 ex Engler).

Distribution : Mangalore.

Flowers : June 1883.

9. COLOCASIA Schott.

Tall herbs, tuberous or with a stout short caudex, flowering and leafing together. Leaves with a stout petiole; lamina peltate, ovate-cordate or sagittate-cordate. Spathe with a stout peduncle; tube ovoid or oblong, convolute, accrescent in fruit, finally irregularly lacerate; lamina oblong or narrowly lanceolate, deciduous. Spadix shorter than the spathe, stout or slender; female inflorescence short, male inflorescence long, cylindric, usually interposed neuters between the two. Appendix erect, elongate-conical or fusiform, subulate or abbreviate, mucroniform. Male flowers 3-6-androus. Female flowers 3-4-gynous; ovary ovoid or oblong, 1-locular; ovules several or many, biseriate; style 0 or short in the beginning, later on 0; stigma depressed-capitate, very shortly 3-5-sulcate. Berries obconic or oblong, many-seeded. Seeds oblong, sulcate. Albumen copious; embryo axile.

Species 7.—Tropical Asia.

Only one species grows in the Presidency, known in Indian Floras under the name *Colocasia antiquorum*, which name has to be changed into:

1. *Colocasia esculenta*, (Linn.) Schott Melet. i, (1832) 18; Kunth Enum. iii, (1841) 37.—*Arum esculentum* Linn. Sp. Pl. (1753) 965, ed. 2 (1763) 1369. *Caladium esculentum* Vent. Hort. Cels. (1800) 30.—*Colocasia antiquorum* Schott l.c.; Hook f. F.B.I. vi, (1893), in Bot. Mag. (1894) t. 7364.—For synonyms see Hook. f. l.c.

Description : Stem above ground 0, or slightly swollen at the base of the leaf-sheaths, arising from a hard tapering rhizome or in cultivated forms a tuberous rhizome, suckers and stolons sometimes present. Petiole erect, up to 1.2 m. long; lamina thinly coriaceous, peltate-ovate, cordate at the base, up to 50 cm. long, rarely longer, with a triangular sinus cut $\frac{1}{2}$ to half way to petiole, with a dull, not polished surface above, paler or coloured beneath, but rarely very glaucous. Peduncle much shorter than the petiole; spathe pale yellow, 15-35 cm. long; tube greenish, oblong; lamina narrowly lanceolate, acuminate, convolute, never widely open, curved slightly backwards in flower. Spadix much shorter than the spathe, rather slender. Female inflorescence as long as the sterile male inflorescence. Appendix much shorter than the inflorescence, style very short. Stigma discoid.

Locality : *Konkan* : Mumbra (Sedgwick 7658 !); Conditia (Blatter and McCann 26375 !); Borivli to Kanari Caves (McCann 1250 ! 1251 !); hills W. of Mulund (McCann 8801 881 !); hills N.-W. of Bhandup (McCann 702 !).—*Deccan* : Satara (Herb. St. X. C. 26389 !).—*N. Kanara* : Nagayali (Sedgwick 2929 !). Widely spread throughout the heavy rainfall area (Sedgwick).

There is not the slightest doubt, that the plant is growing wild in many parts of the Presidency, especially in N. Kanara. Otherwise cultivated.

Distribution : Wild and cultivated throughout the hotter parts of India and Ceylon. Cultivated in all hot countries.

Flowers : July 1917 (Condita) ; Aug. 1929 (Mullund) ; Sept. 1917 (Nagayali, Condita) ; Sept. 1920 (Mumbra).

Fruit : Aug. 1929 (Mullund) ; Sept. 1929 (Borivli to Kanari Caves).

10. ARIOPSIS Nimmo (Cke. ii, 827).

Species 1—India.

1. *Ariopsis peltata* Nimmo in J. Grah. Cat. Bomb. Pl. Addend. (1839) 252 ; Hook. f. in. Bot. Mag. t. 4222 et F.B.I. vi, (1893) 519 ; Cke. ii, 827 ; Engl. Pflanzenr. iv, 23E (1920) 130.—*A. prolanthera* N. E. Br. in Rep. R. Gard. Kew (1877) 57.—*Remusatia vivipara* Wight Ic. iii, (1847) t. 900.

Description : Cke. ii, 827.

The tubers are subglobose or ovoid, 2-4 cm. diam. The lamina of the leaf up to 25 cm. across.

Vern. name in the Konkan ; Khadaktiri.

Locality : *Konkan* (Stocks) ; hills N.-W. of Bhandup in forests (McCann 696 !, 701 !, 703 !) ; Borivli to Kanari Caves (McCann 1203 !) ; Bassein range, Thana Dist. (Ryan !) ; Roha (Damle 542 !).—*W. Ghats* : Khandala (Hallberg !) ; Panchgani (Blatter !) ; Ambe Ghat (Shevade !).—*N. Kanara* : Karwar (Bell 6106 !, 4076 !, Talbot !) ; Karwar and Belekeri (Talbot 494 !).

Distribution : Subtropical Himalaya from Nepal to Sikkim, Assam, Burma, Konkan, W. Ghats from Bombay to Travancore.

Flowers : May 1917 (N. Kanara) ; June (N. Kanara) ; 7th July (Borivli to Kanari Caves).

Fruit : May 1917 (N. Kanara) ; June (N. Kanara) ; July 1929 (Borivli to Kanari Caves).

11. REMUSATIA Schott.

Species 2.—Tropical Africa and Indo-Malaya.

1. *Remusatia vivipara* (Lodd.) Schott Melet. i, (1832) 18 ; Gen. (1858) t. 36 ; Cke. ii, 828 ; Krause in Engl. Pflanzenr. iv, 23E (1920) 16, fig. 4, A-M.—*Caladium viviparum* Lodd. Bot. Cab. (1820) t. 281.—*Colocasia vivipara* Thw. Enum. (1864) 336.—*Arum viviparum* Roxb. Hort. Beng. (1814) 65, Fl. Ind. iii, (1832) 496 ; Wight Ic. iii, (1844) t. 798.—Rheede Hort. Mal. xii, (1703) t. 9.

Description : Cke. ii, 828.

Locality : *Konkan* : Both Konkans (Nimmo) ; clefts of trees in Ghat jungles (Dalzell and Gibson) ; Neral (Bhiva !) ; Bassein (Ryan 1544 bis !) Ambenali (McCann !).—*W. Ghats* : Khandala (Hallberg !, Chibber 53 !) ; Duke's Nose near Khandala, on trees (Meebold ex Engler) ; very common at Khandala (McCann) ; Lonavla (Woodrow !) ; Koina Valley below Mahableshwar (Cooke !) ; Panchgani, cliffs of Tableland (McCann 2867 !, Blatter !).—*S. M. Country* : Astoli, on trees and evergreen (Sedgwick 2649 !).—*N. Kanara* : Sulgeri (Bell 4279) ; Goona (Talbot !), Yellapur (Talbot !).

Distribution : Subtropical Himalaya from Kumaon to Sikkim, Khasia Hills, Burma, Chota Nagpur Konkan, W. Ghats, N. Kanara, Mysore, Ceylon, Cochinchina, Java, tropical Africa.

Flowers : Feb. 1890 (N. Kanara).

Fruit : July 1917 (S. M. Country).

12. RHAPHIDOPHORA Hassk. (not in Cke.).

Creeping or scandent, rooting on trees. Leaves distichous. Petiole geniculate, more or less vaginate. Lamina lanceolate or oblong, more or less oblique, entire or pinnatifid or pinnatisect, often very large ; primary nerves many, secondary branching. Spathe ovate, acuminate, deciduous. Spadix stipitate, dense-flowered, shorter than the spathe. Flowers hermaphrodite or few female. Perianth 0. Stamens 4 ; filaments linear, suddenly narrowed into a thin acuminate connective ; anthers terminal. Ovary long, sub-tetragonous- (or hexagonous-) prismatic, truncate, sub-bilocular, cells several-ovuled, ovules many, parietal. Style almost absent or elongate-conical ;

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- stigma elliptic or oblong. Berries confluent and their tissue loaded with inter-cellular needles. Seeds oblong, attached to a long funicle. Albumen copious. Embryo axile, erect.
- Species 60.—Indo-Malayan.

1. *Rhaphidophora pertusa* (Roxb.) Schott in Bonpl. v. (1857) 45; Hook. f. F.B.I. vi. (1893) 546; Engler Pflanzenr. iv, 23B (1908) 47.—*Pothos pertusus* Roxb. Fl. Ind. i. (1832) 455; Wight Ic. t. 781.—*Scindapsus pertusus* Schott Melet. i. (1832) 21.—*Rhaphidophora lacera* Hassk. Kat. Bog. (1844) 58; Pl. Jav. Rar. (1848) 155.—*Scindapsus peepla* Thw. Enum. (1864) 336.—Rheede Hort. Mal. xii. t. 20, 21.

Description: A tall climber; stem stout, 2.5-3.5 cm. diam.; internodes 5-8 cm. long. Petiole deeply channelled above, 15-30 cm. long, when young with a membranous sheath 12-14 mm. wide below, narrower upwards; lamina herbaceous, broadly ovate in outline, shortly cuspidate at the apex, at the base slightly cordate or subtruncate, unequal-sided, 20-45 cm. long, 15-30 cm. broad, on the narrower side entire or pertuse, holes mostly oblong, the other side pinnatifid; segments 3-4, of equal length, inequilateral, broadened towards the apex, truncate, upper margin obliquely and upwards falcate-acuminate, confluent below; adult lamina pinnatifid, on each side 5-11 linear, obliquely falcate-acuminate segments. Peduncle short, terete, 5-8 cm. long. Spathe fleshy, yellow, ovate-oblong, 10 and more cm. long including the acumen which is 2 cm. long. Spadix sessile, cylindrical, 8-9.5 cm. long and about 1.5 cm. diam. Pistils prismatic, 5-6 mm. long; style tetragonous, very short; stigma subsessile.

Locality: N. Kanara: Goodehalli, in evergreen (Sedgwick 6810!).

Distribution: N. Kanara, Nilgiris, Coromandel, Ceylon, Java.

13. *POTHOS* Linn. (Cke. ii, 828).

Species about 60.—Indo-Malayan, Madagascar.

1. *Pothos scandens* Linn. Sp. Pl. (1753) 968; Bot. Reg. t. 133; Hook. Ic. Pl. ii, t. 175. Cke. ii, 828 (*partim*); Engler Pflanzenr. iv, 23B (1905) 26.—*P. exigui-florus* Schott Aroid. i. (1853) 21, t. 41.—*P. fallax* Schott Prodr. (1860) 560.—*P. decipiens* Schott in Bonpl. (1859) 165.

We have followed Engler in separating *P. scandens* Roxb. and *P. Roxburghii* De Vriese from *P. scandens* as conceived by Hook. f. in F.B.I. vi, 551 and Cooke Fl. Bomb. ii, 828. The description, therefore has to be changed.

Description: Internodes of branchlets 1.5-2 cm. long. Petiole more or less cuneate, 4-5 cm. long, more than 7-9 mm. broad, with rotundate auricles, more or less shorter than the lamina; lamina lanceolate obtuse at the base, gradually narrowed towards the apex, acute, 6-8 cm. long, 1.5-2 cm. broad. Peduncles short, together with the spadix scarcely reaching $\frac{1}{2}$ of the petiole, 1.5-2.5 cm. long; upper cataphylls ovate, acute, about 0.5 cm. long. Spathe ovate or ovate-oblong, apiculate, 7-8 mm. long. Spadix slightly longer than the stipes, 6-7 mm. long about 4 mm. diam. Berries oblong-ovoid, almost 1 cm. long, 5-6 mm. diam.

Locality: *Konkan*: (Stocks); in dense jungles (Graham); jungles of Goa (Lush); Marmagao (Bhival).—*W. Ghats*: Ghat jungles (Dalzell & Gibson); Amboli (Gammie 15022!).—*N. Kanara*: (Chibber!); Devimani Ghat (Kulkarni!); Castle Rock (Gammie 15552! Bhide!); Yellapur (Talbot 4433!); Sumpkhund (Talbot 3692!); Kadgal (Woodrow); Anmod (Sedgwick 3217!); Guddehalli, Karwar (Sedgwick 6785).—Very common in N. Kanara (McCann).

Distribution: Konkan, W. Ghats to Travancore and Ceylon, Sylhet; Assam. Khasia Hills, Chittagong, Andamans, Nicobars, Malay Peninsula, Siam, Cochinchina, Tonkin, Malay Archipelago to the Philippines.

Flowers: Feb. 1905 (N. Kanara); June 1902 (Castle Rock).

Fruit: May (N. Kanara); Nov. 1908 and 1910 (N. Kanara).

(To be continued)

THE BIRDS OF THE PROME DISTRICT OF LOWER BURMA.

BY

J. K. STANFORD, M.C., I.C.S.

WITH NOTES ON THE COLLECTION

BY

DR. CLAUD B. TICEHURST, M.D., M.A., M.B.O.U., F.R.G.S.

PART III.

(Continued from page 915 of Vol. XXXIV).

Burmese Small Yellow-naped Woodpecker (*Picus chlorolophus chlorophoides*). ♂ ♀ 341, 365.

I saw several, nearly all in pairs, between 1,800 ft. and 2,400 ft. near Nyaunggyo in bamboo jungle, which were exceedingly tame. The nuchal crest was frequently raised and very noticeable. I did not see it elsewhere. Oates found it on the Thayetmyo-Toungoo border and not elsewhere in the Pegu Division.

Spotted-breasted Pied Woodpecker (*Dryobates analis*). ♀ ♂ 114, 307.

Oates described it as rather common near Thayetmyo. I only saw two single birds one near Tarokmaw on 3rd February and one in bamboo jungle on 28th March near Prome.

[I do not feel quite satisfied that the race *longipennis* is recognizable. All that can be said is that some Burmese specimens attain a greater wing length than Javan examples; the pectoral spotting is variable in character.]

Northern Yellow-fronted Pied Woodpecker (*Dryobates mahrattensis aurocristatus*). ♂ ♀ 136, 324.

Oates describes it as confined to Northern Pegu but abundant at Thayetmyo 'for some distance down the river.' I shot a single female near Hmawza on 30th March, 1929, in *indaing* jungle which uttered a shrill note quite unlike a woodpecker's. Another was obtained out of a small party near Tonbo on 7th February.

[These belong to the northern race with rather a longer wing and more white on the upper parts than the South Indian bird. I do not consider them to be different from Bengal birds and so they must be called *aurocristatus* instead of *bianfordi*. I see no generic difference between *Dryobates* and *Leiopicus*.]

Burmese Pigmy Woodpecker (*Dryobates h. canicapillus*). ♂ 152.

Oates got it in Pegu and recorded it from Arakan. I shot one out of a pair in the Toney Reserve on 11th February, the only ones seen.

Tickell's Golden-backed Woodpecker (*Chrysocolaptes guttacristatus guttacristatus*). ♂ 268.

I obtained this bird near Prome where it was about the commonest woodpecker. Presumably Stuart Baker's reference to Hopwood taking eggs of *delesserti* in Tharrawaddy in May should refer to this bird.

Northern Rufous Woodpecker (*Micropternus brachyura burmanicus*). ♀ 23.

One was obtained on 18th January, 1929, near Paukkaung. I saw one or two at other times, but it was nowhere common.

[This is a very difficult group of woodpeckers and I think possibly too many races have been recognized. In the *Fauna*, Arakan is given as the type locality of *phaiiceps*, but this is not correct as the type comes from the vicinity

of Calcutta. That being so, I should have hardly thought that another race *mesos* would be found at Kuttak in Orissa. The single bird obtained, has a wing of 135 mm.]

Black and Buff Woodpecker (*Miglyptes jugularis*).

It is probably confined to the hills. Oates obtained it on the Arakan side and says it occurs in evergreen forest on the Pegu side. I saw some small woodpeckers in bamboo jungle near Nyaunggyo which I failed to obtain.

Burmese Heart-spotted Woodpecker (*Hemicircus canente canente*).

Oates (ii; 30) got one near Nyaunggyo. I am fairly certain I saw it there, but failed to obtain any.

Indian Great Slaty Woodpecker (*Mulleripicus pulverulentus harterti*).

Oates obtained it in dense forest on the Arakan Hills.

Burmese Great Black Woodpecker (*Thriponax javanensis feddeni*).

Oates found it 'abundant' at Thayetmyo and east to the Pegu hills, and says he had several specimens from the Arakan Hills. It is not common but I have seen single birds in forest-reserves in the Arakan foot hills, and also one in the Nawin reserves east of Paukkaung in February 1928.

Wryneck (*Iynx torquilla japonica*) ?

Oates observed it yearly as a winter visitor near Thayetmyo. All those I saw were between October and April and all single birds. The latest seen by me was one west of the Irrawaddy near Padaung on 15th April, 1929; I also saw a single bird on the Inma lake on 24th December, 1928.

Burmese Lineated Barbet (*Thereiceryx lineatus hodgsoni*).

Henricks shot one near Theme on 24th February, 1929. It is doubtless common as described by Oates, but I collected very few barbets. It is certainly very common further south in the *Yomas* of the Insein district.

[*T. l. intermedius* seems to be separated as a recognizable race on a wing length averaging a few millimetres less than *hodgsoni*. A series of *hodgsoni* from Nepal, Bhutan and Buxa measure 119-139 mm. and a series from Southern Shan States and Tenasserim 120-135 mm. I am therefore unable to recognize *intermedius* as distinct. If the birds from further south in the Peninsular of Burma and Siam are really distinct, they will require another name. This Prome bird has a wing of 132 mm.]

Blue-throated Barbet (*Cyanops asiatica asiatica*).

Oates only found it in evergreen forest on the east side of the Pegu Hills. The only barbets obtained by me in the Arakan Hills (where, judging by their notes, they were exceedingly common) were of this species. In fact the feature of the table-land on the ridge near Nyaunggyo in April is the enormous number of barbets which can be heard calling in every direction throughout the day.

Burmese Crimson-breasted Barbet (*Xantholæma hæmacephala indica*). ♂ 245, 62. L
Very common in the plains.

Cuckoo (*Cuculus canorus* sub sp.?).

I have never seen it for certain, but Oates (ii. 103) obtained one at Prome in November.

Burmese Plaintive Cuckoo (*Cacomantis merulinus querulus*). 102, 304.

Nearly all I saw were on or around the edges of the big heels near Shwe-daung. Oates notes its partiality for grassy plains and swamps.

Indian Banded Bay Cuckoo (*Cacomantis sonneratii sonneratii*). ♀ 20. 270.

One was obtained near Paukkaung on 18th January 1929, and I shot another on 12th March, out of some bushes on the Nawin stream near Prome. Wardlaw Ramsay got it at Thayetmyo, but it was apparently never seen by Oates.

[The very slight distinctions between *Cacomantis* and *Penthoceryx* do not appear to me to be of a generic character.]

Red-winged Crested Cuckoo (*Clamator coromandus*).

I saw a single specimen on 10th April, 1929, in long grass near the Taungup Pass. It was probably overlooked by me otherwise, though I have frequently seen it in the Insein district.

Malay Koel (*Eudynamis scolopaceus malayana*). ♀ ♀ ♂ 190, 234, 417.

Very common. The bird most frequently cuckolded is probably *Corvus insolens*.

[I agree with Mr. Baker that the Burmese birds cannot, by their larger bill and more rufous underparts in the female, be united with the Indian Koel *scolopaceus*.]

Large Malay Green-billed Malkoha (*Rhopodytes tristis longicaudatus*). 182, 183, 184, 275.

Very common near Prome and probably throughout the whole district.

Common Crow-Pheasant (*Centropus sinensis intermedius*). 249. Local name: *Bok*.

Very common. Nearly always found close to water.

Lesser Coucal (*Centropus b. bengalensis*). 214.

Oates described it as 'local'. I failed to observe it at all, but Henricks got male at Ngaphaw on 25th February.

Large Burmese Paroquet (*Psittacula eupatria indoburmanica*). 413, 414.

I should say this paroquet was common, but I had little opportunity of collecting them. Those shot were in a family party feeding on stubble near Prome on 17th April.

Almost every evening at Prome flocks of paroquets, at an immense height, used to cross the Irrawaddy from west to east. From the pace and height at which they were travelling, they appeared to be coming from the Arakan Hills, which at this point, were only about fifteen miles away. On several occasions I found very large numbers of paroquets coming in to roost in the dense toddy-palm groves along the railway line near Hmawza. I did not see this bird in the Arakan Hills in April.

Eastern Rose-ringed Paroquet (*Psittacula krameri borealis*). 267, 278, 309, 415.

Very common and probably the most abundant of the family. It roosts in large toddy-palms, and breeds there in January and February. I have also seen flocks roosting in mango trees.

[Besides the red bill in both sexes these birds are duller in colour on the upper and under parts than the Indian race.]

Burmese Slaty-headed Paroquet (*Psittacula schisticeps finschi*). 318.

Oates apparently found it on the Pegu Hills. I shot one in scrub near Prome on 30th March out of a pair, and saw others in April, and a few near Nyaunggyo on the Arakan side. I should say it was not common.

Indian Loriquet (*Coryllis vernalis vernalis*). 337.

This bird must be very local, as I do not think I can have overlooked it for two years. The only ones seen were a party of 4 or 5 on 3rd April, 1929, which sat clustered, as if stupefied, on a small tree above Nyaunggyo, and did not move even when I shot one. I saw a single bird near the same place a few days later.

Burmese Roller (*Coracias benghalensis affinis*). 71, 178, 285.

Very common all over the district, except that, on the Arakan side in April, it was not found above 1,000 feet.

Broad-billed Roller (*Eurystomus o. orientalis*).

Oates describes it as comparatively rare and local. I shot one out of a party of five or six at Nyaunggyo on 15th April, 1928, and though looking for it carefully during the following year, failed to observe any. These birds were hawking from the top of an immense dead forest-tree, flying round at a considerable height, but coming occasionally within gun-shot of the ground. They were noticeably more alert and hawk-like than *Coracias affinis*.

Burmese Green Bee-Eater (*Merops orientalis burmanus*). 282.

Extremely common over the whole district, except in the hills, and apparently resident, as I have seen it throughout the year, the other bee-eaters being certainly migratory. It is paired in its breeding haunts by mid-January. I found a clutch of two fresh eggs on 23rd March, 1928, and caught the hen bird in the hole at dusk. In another nest I found naked young at the mouth of the nesting-hole on 16th April, 1928. From observations in the Insein District during August 1928, I am certain this species is migratory there.

Blue-tailed Bee-Eater (*Merops superciliosus javanicus*).

Oates considered this bird to be resident in Pegu. In Prome it is most decidedly a migrant, arriving to breed in mid-March and departing again probably in September or October. I could not get a specimen at all during January or February 1929 though constantly on the look out for it, and saw none up to 20th March. It breeds in considerable numbers in the banks of all the larger streams, and is never seen far from water. The evening flight of this species just before dusk when they are gathering to roost is a very memorable sight. On 4th and 11th April, 1929, I saw pairs and single birds at 3,000 feet in the Arakan *Yomas* which were apparently passing migrants. These were the only ones seen in these hills. This bird nests in April. I have seen it up to late November in the Insein district, but it seems to disappear in the cold weather.

Chestnut-headed Bee-Eater (*Melittophagus e. erythrocephalus*). 209, 210.

Oates described it as found 'sparingly' in forests and well-wooded parts in small flocks and breeding in colonies. The only place where I found this bee-eater was at Ngaphaw in the foot-hills of the Pegu Yoma, where I found several pairs breeding within a few hundred yards of each other along the Ngaphaw stream on 25th February, 1929. I watched at least two pairs excavating nest-holes which were not in sheer banks but in loose sand. Both birds sat close together and assisted in the digging. It may be worth while recording that in the Sunderbuns of the Khulna District (Bengal), Mr. L. R. Fawcus and myself in April 1922 found a considerable number of these birds breeding in little holes like mouse-holes on the flat sand-dunes near the sea. Appears to be resident in the Insein district.

[I see no difference between these and specimens from Ceylon, the type locality.]

Blue-bearded Bee-Eater (*Bucia athertoni*). 399.

In Prome District it is probably confined to the summit of the *Yomas* on both sides. Oates got it near Nyaunggyo where I saw ten or twelve between 2,400 and 3,000 feet in April 1929. They were exceedingly shy and kept to very tall tree-jungle, with the exception of the bird I obtained which was seen two or three times near the same place, and probably had a nest in the bank of the Taungup road. The one I saw at a little distance, appeared to be eating berries in a tree-top. They very rarely returned to the same spot when disturbed, as other bee-eaters do.

Indian Pied King Fisher (*Ceryle rudis leucomelanura*).

Common on the jheels along the Irrawaddy valley. I did not notice it elsewhere. Very tame and prone to hovering unlike other king fishers. I saw what appeared to be recently-fledged young in January 1929.

Common Indian Kingfisher (*Alcedo atthis bengalensis*). 144.

Common all over the district and apparently resident.

Blyth's Kingfisher. (*Alcedo megala*). 412.

Not recorded by Oates. I shot a female on the upper waters of the Nyaunggyo stream on 14th April, 1929, in dense evergreen forest. I am fairly certain it must have been breeding and I saw possible holes in the stream bank near by, but had no time to investigate. This bird does not appear to have been found previously south of the Chin Hills.

Indian Three-toed Kingfisher (*Ceyx t. tridactylus*). 371.

Oates found this bird in evergreen forest on the Pegu Hills. On the Arakan side Mr. Potter shot a male on the headwaters of the Mathon stream, west of

Nyaunggyo on 6th April at about 1,000 feet and we subsequently observed one on a small stream near Nyaunggyo in dense bamboo jungle on 9th April. It is probably easily overlooked.

Burmese Stork-billed Kingfisher (*Ramphalcyon capensis burmanica*). 14.

Quite common and widely distributed. I did not see it in the Arakan Hills.

Indian White-breasted Kingfisher (*Halcyon smyrnensis fusca*). 86.

Abundant everywhere. It feeds largely on insects. I watched a pair on 13th April, 1928, starting to excavate a hole in the Buyo stream. It is much more a bird of the open country than any other.

Black-capped Kingfisher (*Halcyon pileata*).

Oates got it just outside the northern boundary of the Prome district at Pyalo on the Irrawaddy. I have never seen it.

Indian Ruddy Kingfisher (*Entomothera coromanda coromanda*).

A kingfisher of this species flew into my dining-room at Prome on 17th April, 1929, and collided with the *punkah*, whilst three of us were at breakfast. It then flew out of the window into a tree near by and gave me a brief but quite clear view; it was unfortunately disturbed before I could secure it. Oates obtained this species near Pegu.

Great Pied Hornbill (*Dicrurus bicornis*).

I found it common between 2,000 ft. or 3,000 ft. in the Arakan Hills in April and saw large gatherings, apparently of males, assembled on fruit trees on more than one occasion, but failed to secure any.

Burmese Pied Hornbill (*Anthraceros malabaricus leucogaster*). 229, 230.

This appears to be the common Hornbill of the district. Oates found it breeding in March. I shot a male on 28th February at Ngapaw with very enlarged *testes*. This pair used to fly every morning across a wide valley at dawn to feed on a *nyaung*-tree. The female would probably have laid within a week, judging by her ovary.

[No specimens received.]

Malayan Wreathed Hornbill (*Rhyticeros undulatus*).

This was found by Theobald (Oates. ii. 93.) in Sandoway and probably occurs in the hills.

Burmese Hoopoe (*Upupa epops longirostris*). 5.

This bird is common from October to February all over the plains. I found it breeding in the Arakan Hills from 2,000 ft. upwards and cannot recollect seeing any in the plains in 1929 after mid-March. The only nest seen by me was in a hole in a tall tree high up, which one bird constantly visited. While collecting food for their young or sitting mates in these holes, individual birds were exceedingly tame.

Tibetan Hoopoe (*Upupa epops saturata*). 3.

One out of a pair obtained near Prome on 13th March was of this race.

Red-headed Trogon (*Pyrotrogon e. erythrocephalus*). 372.

Common between 2,000 ft. and 3,000 ft. on the Arakan side. I observed trogons at about 200-300 ft. in the foot-hills on the Pegu side, but obtained none. *P. oreskios* according to Oates occurs in Arakan and the 'Pegu hills near the frontier' but I did not see it.

Large White-Rumped Swift (*Micropus pacificus cooki*). 339.

Oates describes them as seen throughout the greater part of the year but usually flying far out of gun-shot in large flocks. In April 1929 this swift was exceedingly common round Nyaunggyo. I only managed to shoot one, but a large flock daily about 9 a.m. used to hawk close over the roof of the bungalow and I saw them also daily on the Taungup road. As it breeds in the Gokteik gorge, it may be found breeding in the Arakan Hills.

Malay House-Swift (*Micropus affinis subfurcatus*).

Oates never found it for certain. I think this is the species which breeds freely in the High Court at Rangoon. I never saw it in Prome.

Eastern Palm-Swift (*Tachornis batasiensis infumatus*). 65.

Breeds in toddy-palms. Common and probably resident.

Indian Crested Swift (*Hemiprocne coronatus*).

Not uncommon in the drier and more open forest. I failed to obtain any.

Burmese Long-tailed Nightjar (*Caprimulgus macrourus ambiguus*). 410.

This was the only nightjar obtained by me in the Arakan Hills. I failed to find it nesting. Its note I have heard also on the east side of the Irrawaddy. It is the syllable 'tuk, tuk, tuk,' repeated three or four times. I repeatedly saw this bird hovering at night.

[This nightjar is quite distinct from the next one. It matches in colour fairly well birds from Singapore (*bimaculatus*) but is too large for that race. ♂ wing 207 mm. Kloss gives the wing measurement of *bimaculatus* as 185-196 mm.]

Nepal Long-tailed Nightjar (*Caprimulgus macrurus nipalensis*). 225.

One shot by me on 27th February at Ngaphaw (200 ft.) was referable to this species. It was in stubble near the Ngaphaw stream.

Common Indian Nightjar (*Caprimulgus asiaticus*). 216.

Common and widely distributed. I did not find it breeding. Oates does not record *C. monticolus* from anywhere in the Pegu Division except Toungoo. The only one shot was near Ngaphaw on 26th February. The call of the commonest nightjar heard at night east of the Irrawaddy was the (four-syllabled) 'tuk, tuk, te tuk,' unlike that of *macrurus*.

Burmese Great-eared Nightjar (*Lyncornis c. cerviniceps*).

Oates describes it as 'very abundant at the foot of the Arakan Hills near Prome', and found it common on the Thayetmyo-Toungoo Yoma. I saw none but have found it since in the Insein district further south. Stuart Baker's description of its breeding near 'Myingyan on the Upper Chindwin' must be a mistake. The area described probably lies in the Upper Chindwin or Monywa districts.

Indian Barn Owl (*Tyto alba javanica*).

I have seen this owl occasionally but never obtained it. Oates describes it as 'abundant over the whole of Pegu'.

Short-eared Owl (*Asio f. flammeus*).

Oates had only one record at Toungoo. I saw a single bird in long grass on the Nawin marshes near Prome on 2nd December, 1928. I know this bird well and there cannot have been any mistake as it was close to me. In November 1924, it may be worth recording, I flushed a number of Short-eared Owls in elephant grass near Tamanthi on the Upper Chindwin.

Burmese Spotted Owlet (*Athene brama pulchra*). Local name:—*Zigwet*.

Oates remarks its abundance in Prome within 15 miles of the Irrawaddy. It is extremely common and far from shy even in daylight and found over most of the district. I watched a pair copulating in December 1927 and again on 1st May, 1928, on a branch immediately after leaving their hollow tree at dusk, a process accompanied by a duet of shrill chattering notes. I have frequently seen these owls hawking flying ants. This owl is one of those which, like the long-eared owl and others, conducts a duet at night in the breeding season.

Jungle Owlet (*Glaucidium cuculoides*). Burmese:—*Zigwet*. 21, 82.

I saw what I think was a specimen of this owl near Paukkaung in January, 1929, and one was brought to me from the same place on 18th January, 1929. I shot another at Kandin on 24th January. This bird has a short single note.

[These owls are very puzzling. The race in Assam to Pegu is said to be *rufescens*, a richly coloured bird of a general rufous brown tint. From a series

of such birds, these two birds from the Prome district stand out at once and are as pale and grey above as *cuculoides* from N. W. Himalayas but are rather more rufous on the under-parts than most. Wing ♂ 146 mm.; ♀ 148 mm. I must leave them as indeterminable till further specimens are to hand.]

Osprey (*Pandion haliaëtus haliaëtus*).

I saw one several times in February 1929 on the Letpanbu jheel and on the last occasion it had become entangled with one of the many fishhooks which Burmans attach to lines fastened to rods in the shallower parts of the jheel. I should not be surprised if it bred along the Irrawaddy valley in this area.

Black Vulture (*Sarcogyps calvus*).

Not uncommon; I have not been certain of its breeding but I think that odd pairs do so in the large *letpanbin* trees on the islands of the Irrawaddy.

Indian White-backed Vulture (*Pseudogyps bengalensis*).

Abundant. I did not collect any vultures and failed to identify *Gyps indicus*. *Pseudogyps* nests in some numbers in the cotton trees of the lower Irrawaddy valley, the nests being largely made of leaves.

Eastern Peregrine Falcon (*Falco peregrinus calidus*).

Oates records obtaining it 'pretty often at Prome'. I failed to observe it.

Burmese Red-legged Falconet (*Microhierax cœrulescens burmanicus*).

This bird is probably easily overlooked and I only procured one in two years, at about 1,000 ft. in the Arakan Yoma foot-hills in April 1928.

Fielden's Hawk (*Neohierax insignis insignis*).

Oates describes it as 'abundant at Thayetmyo extending to the crest of the Arakan Hills.' The only one I saw was a female on 11th March, 1929, about 20 miles east of Prome on the Paukkaung road. This bird had a soft-shelled egg in the oviduct and another in the ovary as big as a marble. Its flight was curiously weak and much more resembled that of a young parrot than a falcon. The gizzard contained a snake. I am very doubtful if this bird is common in the Prome District, but I may have overlooked it.

Burmese Kestrel (*Cerchneis tinnunculus saturatus*). ♀ 103.

Fairly common. I saw no signs of it breeding and it was mainly observed from November to March. Oates considered it a winter visitor only.

Large Grey-headed Fishing Eagle (*Ichthyophaga i. ichthyaëtus*).

I saw a bird two years running sitting on a nest in a large *letpanbin* (cotton) tree at Gwema, in early February. As soon as she left the nest, House Crows made repeated attempts to get at the eggs. As described in the *Fauna*, ed. ii, the nest was in a huge tree close to the bank of the Irrawaddy.

Chestnut Buzzard-Eagle (*Butastur liventer*). ♀ 205.

Not uncommon. A female shot near Theme on 24th February, had an egg in the ovary a little larger than a pea. I saw two pairs on 7th February near Tonbo. A pair were seen constantly in open jungle near Prome from February to April which were undoubtedly nesting, but they were extremely wary and I failed to locate the nest. Oates twice found eggs in March.

Serpent Eagle (*Spilornis cheela burmanicus*). ♂ 129.

I shot a solitary male on 6th February near Nyaunggyo with much enlarged testes. Otherwise I saw no signs of this bird breeding unless some of the birds seen in the Arakan Hills were wrongly mistaken for *Pernis ptilorhynchus*. [wing 451 mm.]

Brahminy Kite (*Haliastur indus indus*).

Common. About March this bird, like *Milvus govinda*, almost entirely disappears and is only seen in very small numbers if at all, until September.

Common Pariah Kite (*Milvus migrans govinda*).

Very common but seems to disappear almost completely by March. Oates (ii 203) says 'from June to September.' Nests in January. In October large gatherings once again become noticeable.

Large Indian Kite (*Milvus migrans lineatus*). ♂ 300.

I obtained one or two but should not describe it as common and I saw no signs of its nesting. Oates apparently only observed it from October to February and did not find it breeding (ii. 204).

Black-shouldered Kite (*Elanus caeruleus*).

I did not obtain this bird but saw several. Oates (ii. 205) only observed them in the rains from June to mid-October, but my experience was exactly the reverse. In 1928-29 I saw one on 9th October, a pair on the Letpanbu jheel on 1st February, and a single bird on 20th March, 1929, all others being invariably seen in the 'open season.' Its habit of hovering and its pale grey colour distinguish it at once in the field.

Marsh-Harrier (*Circus aeruginosus*). 89, 99, 269.

Only three were obtained. In the mature plumage (89 and 269), these birds were exceedingly common. I shot one out of a pair on 1st February, both of which had conspicuous pale heads, the only ones seen in this plumage. These birds were frequently seen a considerable distance from water, hunting the low scrub-hills near the Irrawaddy.

[An adult male on 27th January had just completed the moult of the wings; a female on 1st February is moulting the old whitish feathers of the crown and the new ones in quill are rufous with fine dark central streaks.]

Pied Harrier (*Circus melanoleuca melanoleuca*). ♂ ♂ ♀ 32, 34, 246, 269.

Common from November to March. In the immature plumage (34 and 269) it never seems to associate with adult males which I noticed were nearly always seen in ones and twos. It is spread over the whole district at this time of the year, and is the commonest of the Harriers.

Shikra (*Astur badius poliopsis*). ♂ ♂ ♀ 90, 189, 231.

I shot three; one was a male of a pair which were in my garden on 30th January; the second was a single male in a tree in *indaing* jungle near Prome and the last was a solitary female near Ngaphaw which was hawking insects over a jungle fire in company with kites, swallows and cuckoo-shrikes. The stomach contained two small lizards and a bundle which looked like the remains of a spider.

[These birds are a trifle larger than *dussumieri*, the proportions of wing to tail are the same as in this race (cf. *Fauna*, ed. ii.)]

Crested Honey-Buzzard (*Pernis p. ptilorhynchus*?). ♂ 391.

The only one obtained was shot at 3,000 ft. near Nyaunggyo in April. A buzzard which, I think, belonged to this species, was common here and undoubtedly breeding, and I saw it also up the Mathou stream in April 1928. It has a loud-ringing note of four syllables which can be heard a mile or more away, and has a curious 'display' flight in which the wings are moved rapidly in short strokes. Oates mentions (ii, 203) that he obtained it at Prome and Thayetmyo and apparently found it breeding.

[Longest crest feathers 32 mm.; wg. 431 mm. The crest is fairly well developed and the wing is large for the Indian race *ruficollis*. Forehead and lores ashy grey; under-parts white, barred on the flanks and streaked on the breast with fulvous.]

Siberian Honey-Buzzard (*Pernis apivorus orientalis*)? ♂ 24.

One was obtained near Paukaung by Mr. Williams on 18th January, 1929, and I saw several about this time near the same place. Those I saw were in pairs. They struck me as being very sluggish birds. Oates did not meet them.

[The wing 400 mm. appears to be very small for *orientalis*. A very white bird on the under-parts with heavy median brown streaks on the breast.]

Burmese Black-crested Baza (*Baza leuphotes burmana*).

Oates apparently never met it. I had a close view of one of a pair in high tree-jungle at the Nyaunggyo stream sources on 14th April, 1929. From the white breast and the fact that I noted both birds at the time to be 'as black as crows', there is, I think, no doubt of the species. The crest of the bird I saw

was raised perpendicularly. The note was a whistle like a kite's and I have little doubt they were breeding.

Burmese Green Pigeon (*Crocopus phœnicopterus viridifrons*). ♀ 312.

Oates (BB ii. 307) says that it is 'spread over the whole province alike in the hills and plains', whereas in *Stray Feathers* (vol. iii), he says, 'I have never received it from the Pegu Hills nor from those of Arakan. It is essentially a bird of the plains.'

I did not see any in the Arakan Hills in April 1929. I have seen flocks near Paukkaung as late as mid-May, and others at the foot of the Arakan Hills in mid-April.

[This appears to be *viridifrons* though the wing (sex ♀) is 176 mm.; Mr. Baker gives the range as 184-200 mm.]

Ashy-headed Green Pigeon (*Dendrophasa pompadoura phayrei*). ♂ 353.

Oates says it is confined to the denser forests on the hills. I saw a fair number at 3,000 ft. above Nyaunggyo in April 1929 in the company of Pin-tailed Green Pigeons, where they were exceedingly tame and pairing.

Pin-tailed Green Pigeon (*Sphenocercus a. apicauda*). ♂ 338.

Oates did not meet with this bird at all in Pegu. I found it quite common from 2,400 ft. to 3,000 ft. near Nyaunggyo in April 1929, many being paired and others pairing. They were exceedingly tame and I frequently flushed pairs from the grass on the Padaung-Taungup road, and watched others feeding at very close quarters. They are very parrot-like when in trees. Probably in the Pegu Division it is entirely a bird of the hills.

[This Pigeon has a broad, black band across the central tail, a character omitted in the *Fauna*. *Apicauda* is surely substantive and cannot be altered to *apicaudus*!]

Wedge-tailed Green Pigeon (*Sphenocercus s. sphenurus*). ♀ 333.

Oates says: 'Found throughout the hill portions of Pegu.' I got one, more or less by accident, on 2nd April, 1929, at Nyaunggyo. It was with a flock but I thought the latter were mainly *apicauda*.

Green Imperial Pigeon (*Muscadivora ænea sylvatica*).

Very common in the cold weather, especially just across the Irrawaddy, near Prome. I have not seen any after February and saw none in the Arakan Hills in April.

Indian Emerald Dove (*Chalcophaps indica indica*). ♀ 226.

Common in the denser portions of the district and occurs up to 3,000 ft. on Arakan side, where I found a nest with young a few days old in bamboo on 11th April, 1929. The bird was extremely wary and difficult to observe entering and leaving the nest.

Blue Rock-Pigeon (*Columba livia*). ♂ 181.

Oates never met it though in the *Fauna* (v. 221), Macdonald is quoted as saying that it is 'common in Myingyan.' Large numbers exist in a semi-domestic state round most *pong-yi-kyaungs*. The bird shot by me was drinking at a pool of salt gaseous water.

On two occasions in April 1929, I saw a very large Pigeon going down into dense bamboo-jungle on the hill-side near Nyaunggyo bungalow, but failed to obtain it. The general colour appeared to be dark vinous-brown on the upper parts and its size made it doubtful if it was *Alsocomus puniceus*. This note is placed on record in case *Ducula insignis griseicapilla* is later found breeding here.

Indian Rufous Turtle-Dove (*Streptopelia orientalis meena*). 403.

I saw several pairs near Nyaunggyo in April 1929 where it was probably breeding. I doubt if it occurs elsewhere in the district commonly except in dense jungle, though it is found in evergreen jungle at a much lower elevation in the Insein district.

[This specimen is *meena* of the *Fauna*, ed. ii.; *agricola* of Hartert.]

Burmese Spotted Dove (*Streptopelia chinensis tigrina*).

Very common and more or less resident. A nest found by me on 30th January, 1929, in an isolated cane-brake in the Nawin marshes contained three eggs, the only time I have ever seen a pigeon's or a dove's nest with such a number. Another nest found on 25th December, 1929, near Kyithe and containing newly-hatched young, was made of grass in a bush only about three feet from the ground.

Burmese Red Turtle-Dove (*Œnopopelia tranquebarica humilis*). ♀ 255.

Oates never found this bird breeding, and my impression is that it is a winter visitor to Prome only, arriving in November and the majority leaving in March. During December and January, very large flocks can be seen.

Bar-tailed Cuckoo-Dove (*Macropygia unchall tusalia*).

As Oates did not apparently record it from anywhere west of the Sittang, it may be worth nothing that I saw no signs of it in April 1928 or 1929 in the Arakan Hills.

Burmese Jungle-Fowl (*Gallus bankiva robinsoni*).

Abundant. I do not think that in any part of Burma in which I have been, 'the breeding months are November to March'. (S. B. v. 298.) I have however seen young in Prome on one occasion with feathers beginning to sprout as early as 27th February 1928. In April, 1929, very large numbers of young ones were seen between 1st and 14th near Nyaunggyo. A few of these could just flutter; others were newly hatched, the old hens being extremely tame. No cock-birds were seen accompanying broods. I have seen young birds that could just fly in mid-April 1925, at Thaton in the Tenasserim Division.

Burmese Silver Pheasant (*Gennæus lineatus*). 244, 273.

Oates suspected that both this species and *cuvieri* possibly occurred west of the Irrawaddy valley. Both the Silver Pheasants obtained for me, came from the low hills east of the Irrawaddy between Tarokmaw and the Inma swamp. I saw very few and could not describe its distribution.

Oates's Silver Pheasant (*Gennæus lineatus cuvieri apud*, Oates).

Oates remarks that it occurs 'over the whole of the Arakan Hills, extending, I think, quite down to the Irrawaddy river'. He shot one at Nyaungchidauk just where the Taungup road starts to ascend the *Yoma*. On 14th April, 1929, at Nyaunggyo in evergreen forest I met a female with a single newly-hatched chick. This bird had a pronounced crest and a dark chestnut tail with brown bars. It ran all round me in great excitement clucking in a low tone and ruffling out its feathers like a barn-door fowl. I saw one other hen bird come down to drink a few days earlier at the same stream, but otherwise saw none.

[I have not attempted to work out these pheasants, which are practically topotypes of *G. l. oatesi*, as the material in the British Museum is insufficient. The genus *Gennæus* is a very puzzling one and only carefully collected material with full data together with field notes can throw light on the subject. I stress this, as Mr. Stuart Baker has already stressed it (*Fauna*, ed. ii, V. p. 331), in order to bring home to the 'men on the spot', the only people who can help, the fact that, after all these years, not nearly enough of these Pheasants have been preserved and sent home for a proper understanding to be arrived at, though annually numbers must be killed.

The outline of the problem is as follows:—We have the Black-breasted Kalij of Assam *horsfieldi*, with black predominating on the back, extending into the north of Burma; then the Silver Pheasant, *nycthemerus*, with white predominating on the back, extending from China into the east of Burma; and lastly the Silver Pheasant of the *lineatus* type, with the feathers on the back silver-grey, due to the markings of black and white being about equal, extending into South Burma from Malay. Thus, taking Burma as a whole, we have, according to present ideas, one or more representatives of these three species, but their distribution is by no means clear, and apparently in some cases we have a representative of more than one species, side by side in the same district. If we could be sure of this, then we should know for certain that we have *three* species to deal with, each forming local races. If, however, no two forms are ever found in the same area, then it seems much more likely

that in reality all three Kalij-Silver Pheasants are one species with numbers of races grading from black in the Himalayas to white in China.

Yet a third alternative remains as regards Burma; have we a representative of each of the supposed species which, where they meet, hybridize?

What we want to know therefore is this:—Can one or more recognizable forms be found in the same district? If so, can they be obtained in (a) the same brood, (b) the same locality, (c) or is there an elevational difference in their distribution? Are the same types of females always associated with the same types of males, or are there different types of females in the same area? These are the sort of notes required with specimens, together with precise data as regards date, locality, colour of soft parts, etc.]

Blue-breasted Quail (*Excalfactoria chinensis chinensis*).

I saw a good many when shooting snipe in September and October 1928 in wet grass land on the Nawin marshes, where it probably bred. Not seen elsewhere.

Black-breasted Quail (*Coturnix coromandelica*).

Common 'in Northern Pegu' (Oates). I shot a good many especially in September and October 1928, but did not find it actually breeding.

Arakan Hill-Partridge (*Arborophila rufogularis intermedia*).

Oates obtained a number, all between Nyaungchidaik and Nyaunggyo. I should doubt it if it ever comes below 1,500 ft. on this side except in the rains, as the few I saw were nearly all in or near evergreen jungle, and seemed very partial to water.

Phayre's Burmese Francolin (*Francolinus pintadeanus phayrei*). ♀ 72.

Oates described it as confined to that portion of the Irrawaddy valley 'above Prome'. It was common 20 miles south of Prome and I got it near Padinbin on the south-west border of the district. It will probably be found on the forest outskirts down to Tharrawaddy. It is not uncommon but difficult to flush.

Burmese Button Quail (*Turnix maculatus maculatus*). ♀ 351, 393.

Common and probably resident. It was the only quail I saw in the Arakan Hills where I saw several at 3,000 ft. in pairs and small parties.

Eastern Baiton's Crake (*Porzana pusilla*). ♂ ♀ 143, 247.

I shot one at Letpanbu on 10th February and one at Prome on 5th March, 1929. These birds were very tame and running about close to me.

Oates only obtained one in many years.

Indian Blue-breasted Banded Rail (*Hypotaenidia striata gularis*).

I did not meet this for certain, though Oates describes it as found over the whole Province. When snipe-shooting I twice flushed rails which I failed to secure.

Chinese White-breasted Water-hen (*Amaurornis phoenicurus chinensis*). ♂ 416.

Common: breeds.

Indian Moorhen (*Gallinula chloropus indicus*).

Oates apparently only got one, just outside the northern border of the Prome District in Thayetmyo. It was common in the Nawin marshes at Prome and I saw young ones late in September 1927.

The Water-Cock (*Gallicrex cinerea*).

I only saw one or two on the Nawin marshes at odd times. This is a bird which I have never seen in Burma except singly, and usually in very unexpected places.

Indian Purple Moorhen (*Porphyrio poliocephalus*).

Common and resident on all the big *Sheels* of the Irrawaddy valley.

Coot (*Fulca atra atra*).

Not seen by me. Oates did not apparently find it west of the Pegu Yoma.

Masked Finfoot (*Heliopais personata*).

Oates says he saw one killed on Inma, which is 25 miles south of Prome. In the *Fauna* he says 'I believe I once killed one on the Irrawaddy above Prome but did not preserve it.' As it was found very commonly in the lower reaches of the Myitmaka in Tharrawaddy, it almost certainly occurs on the upper reaches where the Myitmaka takes its source from the Inma Lake. I think I flushed more than one in the Nawin marshes but failed to obtain any. I also heard its note more than once.

Bronze-winged Jacana (*Metopidius indicus*).

Common on the big lakes of the Irrawaddy valley, and in other suitable places; it undoubtedly breeds on Letpanbu and the Kywedalin swamps.

Pheasant-tailed Jacana (*Hydrophasianus chirurgus*). Local name: *bi-gya*.

Oates considered this bird a permanent resident, but I got the impression that the bulk of those I saw on Letpanbu in December 1928 and January 1929 has passed on by March.

Painted Snipe (*Rostratula benghalensis benghalensis*).

It is noteworthy that Oates considered it rare and only obtained it at the end of the rains. Practically the only occasions on which I obtained it were in August and September while snipe-shooting on the Nawin marshes. Some seen then were distinctly immature and it almost certainly breeds on the Nawlin during the rains.

Indian Stone-Plover (*Burhinus oedicnemus indicus*).

I should not be surprised to find this bird breeding on the dry rolling hills on the north-eastern border, though the only one I ever saw was a single bird on 8th July, 1928, on the Nawin marshes, probably a passing migrant.

Great Stone-Plover (*Esacus recurvirostris*).

I looked for this bird carefully on the Irrawaddy and adjacent streams and failed to find it.

Large Indian Pratincole (*Glaucola maldivarum*). 261.

Oates notes its arrival in February and found eggs in March, April and May. It breeds in several places along the Irrawaddy valley and in Prome my earliest records were early March. In 1928, there was a fairly large colony breeding on the Nawin marshes at Prome and I found a single incubated egg on 30th May, 1928. This colony had entirely vanished from the ground on 8th July, and did not return there in 1929 though I saw a single bird on 10th March, 1929, and a pair later on. I also found three or four pairs breeding on burnt stubble near Letpanbu and saw a nest with one incubated egg on 23rd March, 1929. In this situation the egg was extremely difficult to see, even when I knew its exact whereabouts. An unusual decoy trick practised by one sitting hen I watched was to leave the eggs and nestle some yards away, exactly as if she was on her nest.

Small Indian Pratincole (*Glaucola lactea*). 119, 200.

Breeds in very large numbers along the Irrawaddy valley. It appears to be, at any rate, a local migrant arriving in February and is very rare from July to January. Eggs can be found in some numbers from 20th March onwards, though I saw a young one on 21st March, 1929; colonies probably suffer severely from casualties, and I have found eggs as late as 16th May, shortly before the river rose. On this date I also saw almost fully-grown young, which can be distinguished in the field by the pale head and the absence of any black on the forehead.

I attempted to take thermometric records of eggs at 4 p.m. in March and found that a thermometer placed between the eggs registered 105-110 degrees. The usual clutch in this district is *two*, and at least 50 per cent of the nests are placed under isolated tufts of grass or other herbage for shade.

These birds have a very remarkable flight, occasionally seen when hawking low over the water at dusk. They appear to slide just above the surface with wings vibrating rapidly just above the back, the wings never seeming to be brought into a horizontal position at all.

Larus.

I saw no Gulls at all on the Irrawaddy in Prome District, though one might well have expected them, except two on 16th March, 1928, which I only got a distant view of. They may have been *brunneicephalus*.

Whiskered Tern (*Chlidonias leucopareia*). 295, 296.

Oates only observed it from November to May, and did not find it breeding. I did not get a chance to visit the big lakes in the rains and only saw three Whiskered Terns in two years. Two of these were shot on Letpanbu on 22nd March, 1929, and were feeding on a backwater with *S. aurantia*. These birds did not agree with the description in either Oates or Stuart Baker as regards their bill and legs. The mandibles were vinous black and inside of the mouth very dark, vinous red; legs vinous red. The small size and mottled appearance of the head and nape distinguished them from other Terns on the wing.

On 5th and 15th October, 1929, I saw small parties of Whiskered Terns apparently migrating south across country near Tantabin in Insein District.

[Both are young birds in first winter plumage. Bills, exposed, 30-30.5 mm.; moulting tail, wings and body plumage.]

Indian River-Tern (*Sterna aurantia*).

The commonest Tern in the district and nests in very large colonies on suitable sand-banks. My impression is that most of them leave the district after the river rises in June, returning to their breeding haunts in January. The commonest clutch is two, and I have found eggs in numbers by 22nd March. The nest is always in a deep hollow, unlined, in sandy mud.

I watched a male on 22nd March, 1928, 'rolling' in front of the female, with tail vertically erect and wings shuffling, in a manner very similar to the courtship of the Lapwing.

Black-bellied Tern (*Sterna melanogaster*).

This Tern is by no means uncommon and probably resident in small numbers, but I failed to find it breeding. It was certainly not breeding in one very large colony of *Rhyncops*, *S. aurantia* and *S. sinensis* in March, 1929. It appeared to be breeding near Letpankaya in March, 1928, and I saw several 8-10 miles up the Thaledan stream in April, 1928, but again saw nothing to prove that they were breeding. It is the only Tern which wanders far and wide fishing over the smaller streams and road-side ditches of the paddy plain.

White-shafted Ternlet (*Sterna a. sinensis*). 292.

I very much regret that I did not collect more Terns of this species. The only one shot, on an island off Padaung on 21st March, 1929, was, I think, undoubtedly breeding though it was just before dark and I had no time to look for the eggs. This specimen was from a small colony, of which every bird was flying round excitedly, exactly as if they had eggs. On 26th March, 1928, I saw one or two pairs on the same island which showed no signs of breeding. On 16th May, 1928, I found two nests each with two eggs of a Little Tern near Natmaw but did not identify the bird by shooting.

[This is no doubt *Sterna a. sinensis*. ♂ wg. 173 mm.; bill exposed 28.5 mm.; shafts of the first three primaries white. In the *Fauna*, ed. ii, it is said that this Tern breeds on the coast of Burma, whereas the Tern breeding on the rivers of Burma is *pusilla*. Assuming that *pusilla* differs from *sinensis*, this distribution cannot be correct. Robinson and Kloss give *sinensis* as the breeding bird in the Malay rivers.]

Indian Skimmer (*Rhyncops albicollis*). 293.

Oates says the normal clutch is four. The nests found by me never contained more than three and I think incubation starts as soon as the first egg is laid. I found three nests with birds sitting between 22nd and 26th March, 1928, and shot the male of a sitting hen on 21st March, 1929, finding two or three nests on the same date. The nest is always an irregular hollow on the bare sand far from other birds, and I noticed the hen constantly leaving the nest to fly round with her mate. A flock was migrating south down the river on 15th November, 1928.

Kentish Plover (*Leucopoliis alexandrinus alexandrinus*). 115, 116, 314, 315, 316.

Oates never met it. I should say it was fairly common on the Irrawaddy from November to March. I came across a large flock near Tat-maw on 4th February, all exceedingly tame and in very worn plumage, and another large gathering on 24th March in all stages of plumage but with a number of conspicuous chestnut-headed males. Saw nothing to suggest that they breed in the district.

[Two from Tarokmaw on 4th February in worn plumage and three from Thaledan on 24th March in very fresh dress. These I cannot separate from the typical race. Wg. 108-114 mm.; bill exposed, 15.5-17.5 mm.]

• Little Ringed Plover (*Charadrius d. dubius*).

Oates (ii. 371) says he never saw it in 'Northern Pegu.' It is practically impossible to distinguish this and the next race in the field.

Jerdon's Little Ringed Plover (*Charadrius d. jerdoni*) ♂ ♀ 130, 248, 193.

Probably resident. All the Ringed Plovers obtained by me in February and March were of this race. They included one shot at dusk out of a party flying south overland which appeared to be migrating on 5th March, 1929. A Ringed Plover undoubtedly nests in the district, not only on the sand-banks of the Irrawaddy, but on the big shingle banks of the Thaledan and other streams, but I failed to find any nests or identify which race it was. At a short distance seen with glasses, this bird appears to have red eyes. One, which appeared to have a nest close to me at Letpankaya, kept sinking down and pretending to brood, shuffling its wings. This habit is noticeable in *hiaticula* during courtship. It is noteworthy that Oates did not find either this bird or *dubius* breeding.

Eastern Golden Plover (*Pluvialis dominicus fulvus*). ♀ 52, ♂ 242.

Oates remarks that there is one passage from September until November and December but a considerable number remain till April or May. I saw newly-arrived immigrants on 3rd October, 1928, and the earliest usually arrive in mid-September. From then on to March it is common in suitable country, a favourite haunt being the sandy *Kaing*-fields near Shwedaung.

[Two from Shwedaung on 22nd January and 2nd March. Both are young birds moulting into summer plumage; one of them retains a considerable amount of juvenile plumage on the upper parts.]

Spur-winged Plover (*Hoplopterus ventralis*).

Very common and resident. A considerable number breed up all the streams running out of the Arakan Hills. Oates did not find its nest and I found it the shyest and wariest bird to observe, unless a high bank or rise commanded the nesting-ground. I found one clutch incubated on 29th April, 1928, and another on 3rd March, 1929, both on open sand-flats: in neither case was there any attempt at a nest. Judging from parties of 5 and 6 seen in mid-April up the Thaledan and Mathon streams, the males either congregate in the breeding season like Mallard, or there are still unpaired birds passing through.

The crouching of the male bird, when alarmed, is very similar to a habit I noticed in the male Ringed-Plover in England in 1927.

Burmese Red-wattled Lapwing (*Lobivanellus indicus atronuchalis*).

Common and apparently resident, breeding mainly on paddy or fallow land.

Grey-headed Lapwing (*Microsarcops cinereus*).

Common in small parties from October to March and seen usually on the edges of fresh-water tanks. Oates records seeing large flocks at Inma.

Black-winged Stilt (*Himantopus h. himantopus*).

This bird is certainly not a 'resident' over the greater part of Burma (S. B. vi. 193). Oates considered it a winter immigrant only, and though I have seen it in several districts, I have never seen any sign of its breeding, except a small colony which I found in July 1921 near Kinu in the Shwabo district of Upper Burma.

There were six or seven pairs breeding at Kinu on what the Burmans call a 'soap bog', of such a nature that no money would tempt them into it, and I failed to obtain the eggs, though I saw with field-glasses from a distance at least

one hen bird sitting. In Prome the Stilt was by no means common, and I only saw a few. One party of 12 which I saw in late September 1927 arriving over the hill from the north on to the Nawin marshes were, I think, certainly on passage.

Eastern Curlew (*Numenius arquata lineatus*).

I once heard a curlew passing down the Irrawaddy and Fielden got one (as also Whimbrel) at Thayetmyo. Oates never saw it away from the sea-coast neighbourhood.

Green Sandpiper (*Tringa ochropus*). ♂ 95.

Seen in small numbers from August to April. I think Oates's remark that he has generally found 'this Sandpiper in paddyfields in company with Snipe' must refer to *T. glareola*.

Marsh-Sandpiper (*T. stagnatilis*).

I do not think I can possibly have confused this bird with the Greenshank which was common in Prome. Oates describes it as abundant in Pegu on the mudbanks of the larger rivers. I never saw it for certain.

Common Sandpiper (*T. hypoleucus*).

This bird is probably observable from July to May. I have seen it from late July to mid-April and it is common but rarely occurs except in ones or twos.

Wood Sandpiper (*T. glareola*) ♀ 96.

This is undoubtedly the common sandpiper of the district and is found everywhere from July 20th to mid-April wherever there is water or marshy ground. Snipe-shooting in this district and Henzada is nearly always complicated in August and September by the cloud of Wood-Sandpipers rising continually before one, out of which the rising Snipe has to be picked. It is very widely distributed along the Irrawaddy and even found on the bigger hill-streams at low altitudes. I have seen it as late as April 29th.

Redshank (*Totanus totanus* sub-sp.?)

I shot one or two on Inma, but it was nowhere common and I did not see it along the Irrawaddy valley. [No specimens.]

Greenshank (*Glottis nebularia*).

Very common from September to March along the Irrawaddy. I have occasionally seen quite considerable flocks, and it is the commonest large wader.

Temminck's Stint (*Erolia temmincki*) ♂ ♀ 91, 64.

Common in flocks in September and October and a few remain until mid-April. Oates described it as 'comparatively rare', but I think it will be found to be at least as common as *subminuta* which he thought the common stint of the Pegu Division.

Little Stint (*Erolia m. minuta*).

Oates described it as 'by no means common' and apparently procured it only in South Pegu. I saw considerable numbers of Stints in flocks from mid-August onwards, but all those obtained were *temmincki* or *subminuta*.

Long-toed Stint (*Erolia subminuta*) ♀ ♂ 100, 109.

I shot several of these in February and March 1929 on Letpanbu and could always distinguish them from the other stints they were with by the much darker mottlings of the back. I shot it in mid-August in the Insein district in 1929.

[These are darker on the upper parts than *minuta* in similar winter dress due to the dark centres of the feathers having a larger area; the tail feathers are darker and there is a well-defined grey streaked pectoral gorget. The toes are of course noticeably long and slender.]

Woodcock (*Scolopax r. rusticola*).

I can find no records of this bird in Prome, but it is probably overlooked. I had a report of some being seen two miles north of Inma in 1928 and thought I saw one on the edge of the Inma swamp. Mr. Claudius of the Burma Railways shot 3 near Hmawza, a few miles east of Prome, in December 1928.

Common or Fantail Snipe (*Capella g. gallinago*). ♂ 142.

Common but probably does not arrive in any numbers before December and is then confined to the *mayin* paddy on the Irrawaddy jheels. This bird's flight, note, reddish-brown appearance on the wing, and the places it frequents, all distinguish it at once from the Pintail.

[One, February 10th ; I can match this exactly with British birds.]

Pintail Snipe (*Gallinago stenura*). ♂ 6.

Mr. C. E. Milner, I. R. S., first brought to my notice the fact that a large number of Pintail Snipe obtained in September or October, are moulting their primaries and can barely fly. *In litt.* he writes of a day's shooting near Moulmein on 3rd September, 1927. 'A number of birds were killed with primaries only just sprouting: some could hardly flutter. . . As far as I can remember, these birds were all plump and all Pintail and showed 2, 3 or 4 bright blue quills in each wing.' I noticed much the same thing in Prome but did not preserve any. These birds sat very close and flew with difficulty and possibly they moult several of their primaries at once.

In 1927 and 1928, Pintail Snipe had arrived in some numbers on the Nawin marshes by 14th August and were abundant throughout September and October. Later on, when the ground dries up except for the jheels along the Irrawaddy, the bulk of those seen are Fantail. On the Inma lake I have shot this bird in the hottest part of the day out of the shade of bushes on baked mud a considerable distance from water. I noticed the same thing in the Upper Chindwin where one often flushed snipe out of burnt *Kaing* grass. The habit of spending the middle of the day on dry sandy ground far from water is one not uncommon with Snipe in Great Britain, especially in the eastern counties.

Spotted-billed Pelican (*Pelecanus philippensis* ?)

This bird must be rare in the district as I only saw one pelican in two years and did not get near enough to identify the species for certain.

Indian Large Cormorant (*Phalacrocorax carbo sinensis*).

I did not see this bird, and do not think it can have been at all common.

Little Cormorant (*Phalacrocorax niger*). ♂ 291.

A fair number from November to March along the river. This bird breeds in some numbers in palm trees at Kyangin and Seikktha in the Henzada district, a few miles south of the border in company with *B. coromandus* in the rains. I have not actually found it breeding in Prome.

Indian Darter (*Anhinga melanogaster*).

Common.

White Ibis (*Threskiornis melanocephalus*).

I saw a very large flock on Kywedalin south of Tarokmaw on 5th February, 1929, and should not be surprised to find it bred there.

White-necked Stork (*Dissoura episcopa episcopa*).

I saw a pair some way up the Mathon stream in mid-April 1928, which may have been breeding.

Eastern Purple Heron (*Ardea purpurea manillensis*).

Found in small numbers all along the Irrawaddy valley, as a rule singly. Very shy, though occasionally in high rushes birds will allow a very close approach.

Eastern Grey Heron (*Ardea cinerea rectirostris*).

Oates says it probably breeds but he never met it in the rains. I think it is resident in small numbers.

Eastern Large Egret (*Herodias alba modesta*).

Not uncommon but nearly always solitary. (The local name of all bitterns, pond herons, and egrets is *byaing*.)

Little Egret (*Egretta g. garzetta*).

In small numbers. Breeds.

Cattle-Egret (*Bubulcus ibis coromandus*).

This bird feeds largely on refuse near trenching grounds and slaughter-houses. It is the common egret of the district and nests in very large numbers in the heart of Prome town and in suitable places elsewhere. Stuart Baker says it starts to breed in July in Burma, but on 29th April, 1928, the Prome colony started to nest, the material (mainly tamarind twigs) being brought over the Irrawaddy. Pair after pair flew over my house on this errand. On 14th May I saw others building at Paukkaung.

Indian Pond-Heron (*Ardeola grayii*).

Very common everywhere. Breeds in company with *B. coromandus*.

Chinese Pond-Heron (*Ardeola bacchus*).

Oates apparently never discovered this Heron in Pegu, and I am inclined to doubt if it occurs as more than a straggler.

Little Green Heron (*Butorides striatus javanicus*).

Common on the wooded streams such as the Thaledan and Mathon in the Arakan foothills, where I saw it in April 1928.

Night Heron (*Nycticorax n. nycticorax*).

Common and probably resident. In the adjoining district of Henzada I found it breeding in July and August in close company with daylight feeders such as Cormorants and *B. coromandus*, so that the din of the colony never ceased day and night.

Malay Tiger-Bittern (*Gorsachius m. melanolophus*).

I saw one of these on the Mathon stream in the Arakan foothills in April 1928. It was shy but perched for a while in a tree, and gave me a good view of its chestnut-cinnamon back.

Yellow Bittern (*Ixobrychus s. sinensis*).

Not uncommon along the Irrawaddy valley. It is never seen except when flushed from swampy ground. It seemed to disappear almost entirely after October.

Chestnut Bittern (*Ixobrychus cinnamomeus*).

Oates describes it as 'nocturnal in its habits, shy, and very seldom seen.' Stuart Baker describes it as 'crepuscular and shy in its habits.' Like the Black Bittern, I consider this bird in Lower Burma is most conspicuous in the breeding season and pairs may frequently be seen flying round in wide circles in broad daylight, apparently 'displaying'. They also travel considerable distances from their feeding-grounds to their nests, and I have found it a matter of extreme difficulty to mark them down in consequence. This bird appears to be an immigrant in Prome from June to October and disappears as its breeding-haunts dry up.

Black Bittern (*Dupetor f. flavicollis*).

Stuart Baker and Oates remark that this bird is mainly 'nocturnal in its habits'. In the rains when it is presumably breeding, this is very far from being the case and on Hlawga Lake near Rangoon, individuals can be observed at all hours of the day flying strongly, at a considerable height, from their feeding-grounds to places at such a distance that I have been unable with powerful glasses to mark their destination. This bird is not uncommon in Prome and I have reason to think it breeds.

Nukhta or Comb Duck (*Sarcidionis melanotus*) Local name: *Maukhtin* (not *Maukton*; S. B. vi. 385).

Not very common as it falls an easy prey to every Burman with a gun. (It may be noted that Stuart Baker in *Indian Ducks* does not specially record this species from Upper Burma, but I have got it in Shwebo, Sagaing and the Upper Chindwin Districts.) Oates comments on its abundance at Inma. On 5th September, 1927, I saw a female with a brood of young ones at Prome which were well grown but still unable to fly. In the non-breeding season it resorts to sand-banks on the Irrawaddy.

THE BIRDS OF THE PROME DISTRICT, BURMA

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White-winged Wood-Duck (*Asarcornis scutulatus*).

I have seen this bird in the Upper Chindwin and the Insein Districts of Burma. I have no reason to think it occurs in Prome and there is no water in the forest areas suitable for it, but Mr. Milner, I.F.S., informs me it was not uncommon in Tharrawaddy before the War. I saw a pair in Insein District in December 1925 and have several other records of its occurrence there. It may be worth recording that one which I had driven to me in the Upper Chindwin, when shot, ran at a great speed about 200 yards through dense jungle pursued by a terrier and when I eventually forced my way to it, I found it stretched out and feigning death, with the terrier standing over it. The drake and duck of two pairs seen here had separate notes, like Shelduck in the breeding season, the drake a low 'cronk', 'cronk', and the female a whistle, when on the wing.

Cotton-Teal (*Nettapus coromandelianus*). Local name :—*Kalagal*.

Very common from November to March on the big *jheels* of the Irrawaddy valley. I have not actually found it breeding, but in August 1927 saw two adults and a number of young birds which kept flying round an immense *nyaungbin* tree (figus) in Paukkaung and settling on branches fifty or sixty feet from the ground. I have no doubt they had bred there.

Grey Geese (? *Anser indicus*).

The only geese ever seen by me in Prome were a gaggle which was reported in January, 1929, as frequenting the sand-banks and the pea-fields of the Irrawaddy valley near Shwedaung in January, 1929. I made more than one attempt to find them and eventually a gaggle of 20-25 birds flew past me about 100 yards distant on 3rd March, 1929. As I was trying to hide for a shot, I did not get my glasses on to them but think they were *indicus*. It is noteworthy that Oates had no record of geese in Lower Burma or Tenasserim at all. A recent enquiry in the Press has failed to obtain any such records from sportsmen.

Large Whistling-Teal (*Dendrocygna fulva*). Local name :—*Sisali*.

Oates notes that this was the only species he procured in Prome and Thayetmyo and I never found *javanica* in two years though it may occur in the south of the district. *Fulva* was common and undoubtedly breeding near Kyithe in the rains of 1928. Oates noted its abundance on the Inma Lake, where I obtained it.

Ruddy Sheldrake (*Casarca ferruginea*). Local name :—*Hintha*.

Stuart Baker (*Indian Ducks*, p. 141) says that it is 'a very rare straggler' to Southern Burma, which presumably means Tenasserim. It is common from November to March along the Irrawaddy valley throughout the district. Four seen flying south down the river at Prome in mid-November, 1928, were probably migrating.

It also occurs in some numbers on the Hlaing and Irrawaddy rivers on the borders of the Insein and Maubin districts.

Spot-Bill (*Anas pœcilorhyncha* sub-sp. ?).

I have never seen a Spot-bill in Prome and Oates never met with it in Pegu, nor did I ever see any duck which bore any resemblance to it. It is of course common in Upper Burma, particularly so in Sagaing and Shwebo. Mr. Milner, I.F.S., shot two on Kya-In just south of the Prome border in Tharrawaddy District on 8th January, 1910. He also saw two on the Ataran river, Moulmein, in December 1924.

Gadwall (*Chaulelasmus streperus*).

Oates never met it in Pegu, nor have I in Prome or elsewhere south of Shwebo District. Mr. E. B. Bloech informs me that he has never met it in many years, shooting in the southern part of the Pegu Division. Mr. Milner says he identified two small lots on the Ataran river (Moulmein) with glasses in December 1924 'without any possibility of doubt'. A recent enquiry made by me through the medium of the Press failed to elicit any other records of Gadwall in Lower Burma.

Shoveler (*Spatula clypeata*).

Stuart Baker (*Game Birds*, vol. i, p. 236), says that it has 'not yet been recorded from Pegu or Tenasserim'. I shot one on the Inma Lake on 24th December 1928, and saw one or two on the Letpanbu jheel in January 1929. It was certainly not common. Oates apparently never met it. Mr. Bloech, who knows the bird well, informs me that he has shot it a few miles north of Pegu town and also on the Hlaing river in the north of the Insein District. Mr. Milner saw a small party of Shoveler in Ataran (Moulmein) in 1924 of which he had a good view with field-glasses.

Wigeon (*Mareca penelope*).

Oates never met it and apparently disbelieved the statement that it occurred in the Pegu Division. Mr. Bloech informs me that he has shot it on Pyinbongyi, a few miles north of the town of Pegu, and also on the Hlaing river in the Insein District, but these were only isolated occurrences.

Common Teal (*Nettion crecca*). ♀ 126, 162.

Fairly common from November to February along the Irrawaddy.

Pintail (*Dafila acuta acuta*).

Oates (ii. 280) found it in some numbers at Inma and considered it the commonest of the larger migratory ducks. I saw considerable numbers on the Letpanbu jheel and the Irrawaddy in January and February 1929 and shot several.

Garganey (*Querquedula querquedula*). Local name: *Bè*.

As Oates remarks, it is the commonest duck in Lower Burma. The earliest seen by me were four on 28th September, 1928, on the Nawin, and a party near Shwedaung on 30th September of the same year. Very large numbers frequent some jheels on the Irrawaddy. I have seen odd birds as late as March, in which month it is sometimes very common in Upper Burma on migration.

Tufted Pochard (*Nyroca fuligula fuligula*). ♀ 141.

Oates had no record of this bird in Pegu or Tenasserim and there were apparently none up to 1921. I shot one out of a party on the Letpanbu jheel on 29th December, 1928, and saw a fair number on the same water. I also got another female on 10th February, 1929, in the same place.

Indian Little Grebe (*Podiceps ruficollis capensis*). 110, 111. Local name:—*Bè*.

A considerable number flocked on Letpanbu in January and February 1929. Oates also got the species in Prome and considered it a resident.

THE MAMMAL SURVEY OF THE EASTERN GHATS.

REPORT ON THE MONKEYS.

BY

R. I. POCKOCK, F.R.S.

The Bonnet Macaques (*Macaca radiata*) and the Langurs (*Pithecus entellus*) recently obtained by Messrs. N. A. Baptista and V. S. La Personne on the Mammal Survey of the Eastern Ghats are sufficiently interesting to call for special notice. Their examination and comparison with examples previously secured by the Survey and already recorded in this Journal have incidentally brought to light some new facts demanding a revision of these monkeys in Southern India.

THE BONNET MACAQUE (*Macaca radiata*).¹

The localities, dimensions and other particulars of the examples of this monkey, supplied by the collector, N. A. Baptista, are as follows:—

Locality and Sex	Length of Head and Body.	Length of Tail.	Total Length.	Weight.	Date.
Malakondapenta, Kurnool District ♂	1' 8 $\frac{1}{2}$ "	1' 10 $\frac{3}{4}$ "	3' 7 $\frac{1}{2}$ "	12 lbs.	May 14
" " " ♂	1' 7 $\frac{3}{4}$ "	1' 9 $\frac{1}{4}$ "	3' 5 $\frac{3}{4}$ "	10 "	" "
" " " ♀	1' 5 $\frac{3}{4}$ "	1' 7 $\frac{1}{4}$ "	3' 1 $\frac{3}{4}$ "	6 $\frac{1}{2}$ "	" "
Shevaroy Hills, 4,500' ♂	1' 9 $\frac{3}{4}$ "	2' 0 $\frac{3}{4}$ "	3' 10 "	14 $\frac{1}{2}$ "	" 19
Karumbapatti, Salem ♀	1' 5 $\frac{3}{4}$ "	1' 9 "	3' 2 $\frac{3}{4}$ "	...	Apr. 21

As will be explained in a subsequent paper, these skins, collected in April and May before the moult, are long and shaggy in the coat and pallid from fading, the distal portion of the hairs being greyish buff for a long distance. So far as their dimensions and weights

¹ By Blanford and many writers on Indian Monkeys this species was cited as *Macacus sinicus*; but Hinton and Wroughton (*Journ. Bomb. Nat. Hist. Soc.* 27, pp. 813-815, 1921), have shown that the name *sinicus* was given by Linnæus to its Ceylonese ally, the Toque Macaque, and that *radiata* is the earliest name that can be assigned to the Indian species. The correctness of this conclusion does not admit of a doubt.

are concerned they agree tolerably closely with other examples obtained by the Survey farther to the west and south in India; and the particulars supplied show the average differences in size between the sexes.

Some dimensions in millimetres of the skulls are as follows :—

Locality and Sex	Total Length	Zygom. Width	Orbital Width	Length of Upper Molars	Lower Jaw
Malakondapenta, Kurnool. ♂ ad.	116	78	60	32	83
„ „ ♂ subad.	110	73	58	31	76
„ „ ♀ just ad.	95	65	52	28	65
Shevaroy Hills. ♂ just ad.	120	76	61	33	86
Salem. ♀ ad.	105	64	55	30	74

As may be seen, the Kurnool specimens are noticeably smaller than those from the Shevaroy Hills. But a few millimetres in a monkey's skull, although on paper they suggest a considerable difference, do not in reality amount to much. The Shevaroy specimens, male and female, are as large as any obtained by the Survey from other localities and preserved in the British Museum.

THE LANGURS

Pithecus entellus.

When I published the monographic revision of the Indian Langurs assigned to *Pithecus entellus* (*Journ. Bomb. Nat. Hist. Soc.*, Vol. XXXII, pp. 472-498, 1928), there were no available specimens of the species from the south-eastern area of the peninsula to compare with the large numbers of specimens obtained by the Mammal Survey in the central, western and southern districts. As was to be expected therefore, the examples of this species recently collected in the Eastern Ghats prove to be of exceptional interest and in a great measure bear out the opinion I expressed (p. 478) that 'further collections in areas not yet investigated, like the eastern parts of India from Orissa to south of Madras, will almost certainly bring to light new local races and will perhaps show that some of the forms here nominally distinguished are based upon characters not deserving that distinction.'

The following examples were secured: four females of various ages collected in April at Diguvametta in the Kurnool District, one Sault female collected in November in the Nallamalai Hills, 2,000', d. Kurnool, one adult female collected in June at Dasarladoddi, the Palkonda Hills, 1,600', and one adult male collected in July at Tirthamalai, Salem, 1,000', in the Shevaroy Hills. Provisionally at all events I assign the Kurnool specimens to *Pithecus entellus anchises* and the Palkonda and Salem specimens to *Pithecus entellus pallipes*.

Pithecus entellus anchises, Blyth

Presbylis anchises, Blyth, *Journ. As. Soc., Bengal*, Vols. XI, p. 470, 1844, and XVI, p. 733, 1847.

Pithecus entellus anchises, Pocock, *Journ. Bomb. Nat. Hist. Soc.*, Vol. XXXII, p. 488, 1928.

Blyth gave the name *anchises* to the skin of a langur from an unknown locality in the Deccan, describing it as like typical *entellus*, which has jet black hands and feet strongly contrasted with the paler arms and legs, but differing in having the hands mixed white and blackish and the feet whitish with dusky black above the base of the toes and on the terminal phalanges, the leg from the knee whitish and the coat very long.

The length of the coat in this specimen probably indicates that it was killed in mid-winter. But the chief interest of the skin lies in its supplying an intermediate stage in the tint of the hands and feet between typical *entellus* and typical *pallipes*.

In my paper, above quoted, I provisionally assigned to *anchises* some specimens obtained by the Survey, namely, a long-coated form collected in November in Hewra in Nimar, 1,000', and two from Seone Malwa, C. P. (S. H. Prater). These monkeys, as was pointed out, are not exactly alike, nor do they agree precisely with the description of *anchises*; but the Nimar specimen is intermediate between typical *entellus* and typical *pallipes* (cf. infra) in the coloration of the hands and feet; and one at all events of the examples from Seone Malwa is intermediate between typical *entellus* and *achates* in having the head somewhat paler than the shoulders, and between these two black-handed and black-footed races and the pale-handed and pale-footed *pallipes* in the partially pale hands and feet.

In the specimens from Diguvametta in Kurnool the hands and feet are paler than in the specimen from Seone Malwa, but the fingers and toes are brown or black and sharply contrasted with the grey tint of the arms and legs which spreads on to the top of the hands and feet. In the oldest specimen the contrast is most marked, the blackness of the digits extending along the inner edge of the hand and foot almost to the wrist and ankle. This specimen, too, is greyer and less buffy on the back than the others and has a decidedly grey patch on the crown of the head, thus approaching the condition seen in typical *entellus* and *pallipes* in which the top of the head is the same or almost the same tint as the shoulders and back. In the others the crown shows scarcely a trace of grey and is slightly paler than the back and shoulders, thus approaching the condition seen in *achates*, *iulus*, *priamellus* and other more western and southern forms in which the buffy head is sharply contrasted with the dark shoulders and back. In all these Kurnool specimens the cheeks, ventral surface and inside of the limbs and buttocks are whitish grey, or, at most, faintly tinged with buff, but there is a very appreciable amount of buff on the chest, and only an inch or so of the tip of the tail is pale.

The example from the Nallamalai Range, 2,000', shot in November, resembles those obtained in April at Diguvametta in the

general hue of the upper side of the tail, the outside of the limbs; the hands and feet, and the crown is slightly paler than the shoulder, but the cheeks, buttocks, lower side and inside of the limbs are much more deeply suffused with buff. This skin is hardly distinguishable from the one, referred to above, from Hewra in Nimar, also procured in November, except that the coat is not so long. But, as explained below, this Langur differs from the Hewra specimen as well as from the other Kurnool examples in some cranial characters.

With the conversion of millimetres into English inches, the following table gives the weights and measurements taken in the flesh of the Kurnool examples:—

Locality and Sex	Head and Body	Tail	Total	Weight
Diguvametta, ♀ old	2' 1 $\frac{3}{8}$ "	3' 3 $\frac{3}{8}$ "	5' 4 $\frac{1}{2}$ "	24 lbs.
" ♀ ad.	1' 11 $\frac{1}{8}$ "	3' 2"	5' 1 $\frac{1}{8}$ "	23 "
" ♀ yng. ad.	1' 10 $\frac{3}{8}$ "	3' 1 $\frac{3}{8}$ "	5' 0"	22 "
Nallamalai, ♀ ad.	2' 0"	2' 11"	4' 11"	...

These particulars agree very closely with those of the females of *pallipes* and *thersites* given below.

The skull measurements in millimetres of the same specimens are as follows:—

Locality and Sex	Total Length	Zygom. Width	Orbital Width	Length of Upper Molars
Diguvametta, ♀ old ...	108	85	69	34
" ♀ ad. ...	105	81	66	35
" ♀ yng. ad.	105	82	67	34
Nallamalai, ♀ ad. ...	106	85	66	30

As may be seen by the difference in the length of the upper molar series, these teeth are all smaller in the Nallamalai specimen, the first upper molar, penultimate tooth, being nearly 1 mm. shorter and narrower. The lower jaw too is different in shape owing to the greater development of its ascending ramus which has the lower and posterior edges more produced and the two rami are more widely divergent behind. In other characters the skulls are very similar: and on the evidence of one skull only from Nallamalai, nothing at present can be done with the differences beyond recording them.

Pithecus entellus pallipes, Blyth.

Semnopithecus pallipes, Blyth, *Ann. Mag. Nat. Hist.*, p. 312, 1844 (April).

Semnopithecus priam, Blyth, *Journ. As. Soc., Bengal*, Vol. XIII, pp. 470 and 476, 1844 (after October).

Semnopithecus priamus, Blyth, *Journ. As. Soc., Bengal*, Vol. XVI, pp. 732 and 1271, pl. 54, 1847 (in part); also Anderson and Blanford (in part).

When I described this race of *Pithecus entellus* two years ago, I followed Blyth, Anderson, Blanford and others in regarding the big langur, with the tufted head, which is found in Ceylon, as racially identical with the similar langur occurring in parts of southern India. And this course was justified by the close similarity in colour, size and other features between a number of examples from Ceylon and the only two Indian examples in the British Museum, namely, two adult males, one ticketed 50 miles S. of Trivandrum, Travancore (Col. F. W. Dawson), the other Arambo, at the foot of the Mahendragiri Range, Travancore (R. S. Pillay).

By the authors just quoted, and others, this Langur was called *Semnopithecus* or *Presbytis priamus*, although the earliest name Blyth gave to it was *pallipes*.

Now the typical examples, three in number, of *pallipes* (*priam*) came from the Coromandel Coast as stated by Blyth in 1843. Comparing this langur with *entellus* (*sensu stricto*), he said it has 'nought of the yellowish tinge and more of the *lait* in the chocolate au lait' tint of the body, the hands and the feet being pale and resembling the rest of the limbs, and the whiskers and nape whitish. In 1846 he extended the range to Ceylon and, on the authority of Jerdon who told him the species was common at Tellicherry, to the Malabar Coast.

In 1879 Anderson altered and amplified Blyth's description of the Coromandel specimens declaring them to be pale ashy grey on the top of the head, the back, the outside of the arm, the upper part of the thigh and the tail, apart from its paler tip, whereas the sides of the head, the nape, the lower half of the thigh, the hands, feet, under side of the body and inside of the limbs are yellowish. Anderson also pointed out that Ceylonese specimens are much darker, being of a pale vinaceous brown on the back, the crown, the outside of the limbs and the tail. Herein lies the interest of the adult female collected by N. A. Baptista on June 29 at Dasarladoddi, 1,600 feet in the Palkonda Hills in Cuddapah and the adult male collected in July at Tirthamalai 1,000 feet in the Shevaroy Hills in Salem.

In the male, the general colour of the upper side from the crown of the head to the root of the tail is olive or brownish grey, the nape being buffy and in conjunction with the white cheeks and brow-band setting off the tufted crown. The outsides of the upper arm and thigh are the same tint as the back, but below the elbow and knee the limbs become gradually paler, the hand being pale grey and blending with the wrist, whereas on the leg the grey dies out at the ankle leaving the foot white with some darker hairs on

the knuckles. The tail apart from the tip is blacker grey than the back; and the under side, the inside of the limbs, like the whiskers, are whitish.

This male does not seem to differ in any respect from Blyth's brief description of *pallipes* (*priam*); but the female, which resembles it in the tint of the upper side, differs in having the brown of the crown paler and blending more with the frontal band and cheeks, which are not so white and the nape considerably paler, the chest and belly decidedly washed with buff, some black hairs on the fingers and more grey on the toes. In the tint of the pale parts at least it recalls the examples described by Anderson; and since the Palkonda Range is midway between Kurnool to the north and Salem to the south, it is interesting to note that but for the tuft on the crown and the paler hands and feet in which it is more like the male from Salem, it is not separable from the examples from Kurnool assigned to *anchises*.

Both these specimens bear out Anderson's statement that Coromandel Coast Langurs with the tufted crown and hands and feet the same tint as the arms and legs are paler than Ceylonese examples exhibiting the same features. Now that I have seen Coromandel Coast examples, I think the two types represent distinct local races. The Coromandel form carries the very appropriate name *pallipes* and the Ceylon form the name *thersites* given by Blyth in 1847 to an isolated example, secured near Trincomalee, which he named because it had no tuft on the head. This tuft, however, although present in perhaps 95 per cent. of Ceylonese examples, is not invariably present. In addition to Blyth's record of its absence in the type of *thersites*, Kelaart recorded a second case and one of several specimens collected by Major E. W. Mayor for the Survey at Mankeni, near Trincomalee, constitutes a third.

As stated above, there are two examples of Langurs in the British Museum, from Travancore, which seem to be inseparable in colour from the Ceylon form, *thersites*. The question now arises: to which of the two races, *pallipes* or *therstes*, do the Langurs of this type inhabiting the Nilgiri Hills belong? I have seen no skins from these hills, only two skulls certified by Blanford and Thomas as having been taken from head-skins referable to *priam*. But this opinion must be taken *cum grano* and left as uncertain until skins come to hand to settle the point.

When I discussed this Ceylonese Langur in 1928, I had only a few specimens for examination. Since then Mr. T. Fry has shown me a very large number of skins and skulls collected for the Survey in various parts of the island by Major E. W. Mayor. Some notes on this fine series may be useful.

Although the colour of these Langurs is subject to considerable variation, I have been unable definitely to associate the variations either with locality or season.

In a series collected at Mankeni in September and October the general colour of the back and head is typically dark-brown with a varying amount of paler buff-tipped hairs on the nape and a general absence of long glistening hairs on the body. The arms above are

like the back, but below they lose the brown hue, the tint, passing into blackish grey on the hands. The thigh, apart from the pale buttock, is like the back, but below the knee the leg becomes paler and greyer passing gradually into the pale whitish grey foot. The tail also is like the back apart from its pale tip. The whiskers, under side and inside of the limbs, are greyish white.

One female, however, collected on September 28, is a good deal paler than the others, the hairs of the neck, shoulders and fore back having long buffy tips as if the coat was old and fading. This is the example referred to above which has no definite crest on the crown.

Several specimens collected at Cheddikulam in November and December generally resemble the darker specimens from Mankeni. But one adult male, shot on December 3, has more long glistening hairs on the shoulders and back. Another adult male has the cheeks, throat, chest and abdomen tinged with buff, like one of the specimens from Travancore. Two females, collected on December 2, are paler and shabbier looking in the coat.

A male from Kala Oya, shot on May 14, is dark brown like the September Mankeni specimens; but a female from Tammanewa, near Kala Oya, killed in the same month is paler than the Mankeni set, but the coat is in no sense deteriorating.

A female from Ranna (S. P.), collected on May 20, is also palish brown but the streaky look of the pelage suggests the imminence of the moult. A young female taken two days earlier at the same place is buffy grey in hue, the palest Ceylonese specimen observed.

An adult female, shot on June 10 at Kirinda (S. P.), has a markedly faded washed-out appearance, being 'straw coloured' over the shoulders with an abundance of very long rather coarse hairs with bleached glistening ends. But a male from Welligatta, shot on June 24, is in colour and texture of coat hardly distinguishable from the male shot at Cheddikulam on December 3. A female from Arucam Bay, shot on August 22, has a pale faded appearance.

These contradictory details show the difficulties in the way of understanding the changes in colour and coat of this Ceylonese Langur. The explanation of them will probably be reached only by an intensive study of the monkeys by some naturalist resident in the island.

The principal dimensions and weights, taken in the flesh, of some of the langurs assigned to *P. entellus pallipes* and *P. entellus thersites* are as follows:—

Locality and Sex		Length of Head and Body	Length of Tail	Total Length	Weight	—
Salem, E. Ghats,	♂ ad.	2' 11 $\frac{1}{2}$ "	3' 3 $\frac{1}{2}$ "	5' 4 $\frac{1}{2}$ "	37 lbs.	<i>pallipes</i> .
Arambo, Travancore,	♂ ad.	1' 11 $\frac{3}{4}$ "	2' 8"	4' 7 $\frac{3}{4}$"	...	...

Locality and Sex	Length of Head and Body	Length of Tail	Total Length	Weight	—
Cheddikulam, Ceylon, ♂ ad.	2' 1"	3' 6"	5' 1"	25½ lbs.	<i>thersites.</i>
" " ♂ ad.	1' 11½"	2' 8"	4' 7½"	29½ "	"
Mankeni, " ♂ ad.	2' 0"	2' 11½"	4' 11½"	27½ "	"
" " ♂ ad.	1' 10¾"	2' 8¾"	4' 7½"	24½ "	"
Palkonda Hills, Cuddapah, ♀ ad.	1' 11½"	3' 1½"	5' 1"	19½ "	<i>pallipes.</i>
Cheddikulam, Ceylon, ♀ ad.	1' 10"	2' 7"	4' 5"	19 "	<i>thersites.</i>
Mankeni, " ♀ ad.	1' 8¾"	2' 8¾"	4' 5¾"	16 "	"
" " ♀ ad.	1' 9"	2' 5"	4' 2"	14 "	"
Arucam Bay, " ♀ ad.	1' 10½"	2' 6¾"	4' 4½"	...	"

From this table it will be seen that the male of *pallipes* from Salem, although only slightly longer than the longest male of *thersites*, is considerably heavier than the heaviest and about 10 lbs. heavier than the average weight of the four males, the largest recorded, of the Ceylon race entered in the table. The figures bear out Blanford's guess that 'Madras specimens are probably larger than Ceylonese'.

Some cranial measurements in millimetres of the Indian specimens and a few of the Ceylonese are as follows:—

Locality and Sex	Total Length	Zygom. Width	Orbita Width	Length of Upper Molar	—
Salem, E. Ghats, ♂ ad.	127	102	80	36	<i>pallipes.</i>
Arambo, Travancore, ♂ ad.	123	95	78	32	? <i>thersites.</i>
Nilgiri Hills, ♂ ad.	122	97	78	34	? <i>pallipes.</i>
Valaichenai, Ceylon, ♂ ad.	119	87	71	29	<i>thersites.</i>
Cheddikulam, ♂ old.	118	91	76	30	"
Mankeni, ♂ ad.	113	89	67	32	"
" ♂ ad.	109	87	72	30	"
Palkonda Hills, ♀ ad.	106	81	67	33	<i>pallipes.</i>
Nilgiri Hills, ♀ ad.	102	84	65	30	? <i>pallipes.</i>
Mankeni, ♀ ad.	103	75	60	30	<i>thersites.</i>
Kala Oya, ♀ ad.	100	82	68	30	"
Arucam Bay, ♀ ad.	100	77	60	28	"

The skull of the example *pallipes* from Salem is noticeably bigger in all the dimensions recorded than the skulls of the males of *thersites*, the largest available for measurement. The skulls from the Nilgiri Hills and Travancore are nearly intermediate between the two. These two skulls differ extraordinarily in shape, as illustrated and described on p. 497 of my paper already quoted. The skull from Salem serves to link in a measure the differences between them. The forehead is flatter than in the Travancore skull, the nose is intermediate in prominence between the two, the occiput is not so uptilted and the mandible is not so massive and arcuate nor is its symphysis so long as in the example from the Nilgiris.

The teeth of *pallipes* are also bigger than of *thersites*. This is shown in the table by the greater length of the upper molar series in the male from Salem and the female from the Palkonda Hills as compared with that of the examples from Ceylon, and the first true molar, the penultimate tooth of the row, is nearly 1 mm. longer and broader in the Coromandel than in the Ceylonese specimens. In the Nilgiri Hill and Travancore specimens, the teeth are of the larger kind.

SOME BEAUTIFUL INDIAN TREES.

BY

E. BLATTER, S.J., Ph.D., F.L.S. AND W. S. MILLARD, F.Z.S.

PART VI.

(With two coloured plates, two black and white plates and 5 diagrams.)

THE CASSIAS.

Cassia is an ancient Greek name for a genus which comprises some 400 different trees, shrubs and herbs, some of them famed for the beauty and profusion of their flowers, others for their medicinal value. The genus is included in the family *Cæsalpiniaceæ* which is named after the Italian botanist Andreas Cæsalpinus who flourished between 1519 and 1603. We propose to illustrate in colour 3 species of this genus which are noted for their showy flowers and to refer more briefly to a few others, which are as commonly cultivated.

THE INDIAN LABURNUM

Popular names : Indian Laburnum, Golden Shower, Pudding Pipe Tree, Purging Cassia (Engl.); Casse officinale, Casse Mondée (French); Röhrenkassie, Fistelkassie (Germ.); Cana fistula (Spanish); Amaltas, Girmalah (Hind., Duk.); Alash, Ali, Karangal, Kiar, Kaniar (Pb.); Raj-briksk, Kitola (Kumaon); Raj Briksha (Nepal); Chimkani (Sind); Sundali, Sonali, Amultas, Bandarlati (Beng.); Nuruic (Santal); Sonawir (Mal., S.P.); Hari (Kol.); Dunras (Karwar); Rajbirij (Nepal); Sonalu (Garó); Bonurlate, Bonurlauri (Palamow); Sunaru (Ass.); Bandolat (Cachar); Sandari or Sunari (Uriya); Kitwali, Kitoli, Itola, Shimarra, Sim (N.W.F.P.); Warga (Oudh); Jaggarwah, Raila, Hirojah, Karkacha (C.P.); Raella (Baigas); Jaggra, Jagarua, Kambar, Rera (Gond); Banag, Bangru (Kukru); Bahava, Bhawa, Baya, Bawa (Mar.); Garmal or Garmals (Guj.); Konraih-kay, Skarak-konraih-kay, Kone (Tam.); Relu, Relarala, Rela-kayalu, Suvarnam (Tel.); Konnak-kaya (Mal.) Kakee (Kan.); Khiyar-shanbur, Katha-ul-Hind (Arab.); Khiyar-chanbar (Pers.); Suvarnaka, Aragbadha, Rajataru (Sans.); Ahalla or Ahilla (Sing.); Gnoosway, Gnoo-kyee (Burm.).

Cassia fistula Linn. Sp. Pl. (1753) 377. Cassia is the old Greek name of Dioscorides, *fistula* means a pipe alluding to the tubular shape of the fruit.

Description : This beautiful tree is frequently planted on city roads and avenues. Laburnum Road in Bombay derives its name from the number of Laburnums planted there,

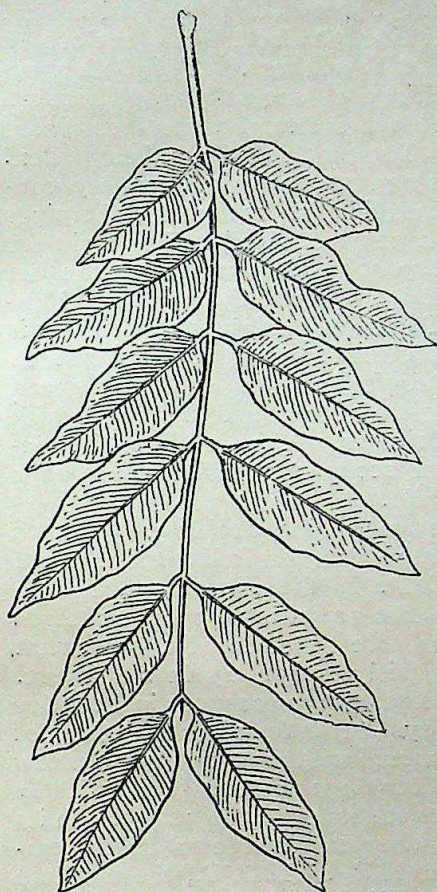


John Bale Sons & Danielsson, Ltd. London

THE INDIAN LABURNUM.
Cassia fistula, Linn.
($\frac{1}{2}$ nat. size)

It is a more gracefully shaped tree than the English Laburnum. The Indian Laburnum is a small, upright tree which grows to

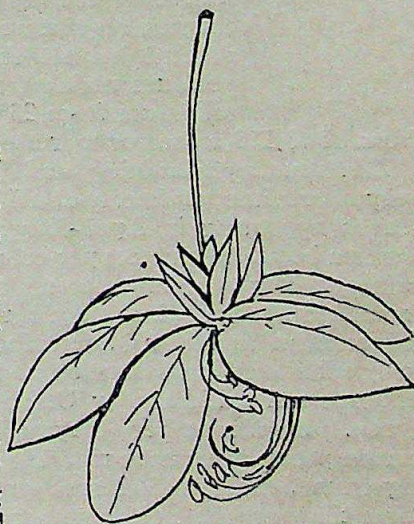
a height of 20 or 30 ft. Its trunk is short, its branches slender, upright and spreading ; its foliage of the deepest green. In young trees the bark is smooth and ash-coloured. In older trees it becomes rough and dark brown. The tree has a compound leaf. The pubescent or slightly downy main-stalk or rachis of the leaf, 9 to 16 inches long, bears from 4 to 8 pairs of leaflets. Those growing about the base of the rachis are broadly ovate in shape, while the leaflets nearer its tip are more oblong and blunt ended. The leaflets grow opposite or nearly opposite one another. They are from 2 to 5 inches long and about $1\frac{1}{2}$ to $3\frac{3}{4}$ inches broad. They are smooth above and covered with fine veins, more conspicuous on the under surface of the leaflet. The tender leaves are bright green and covered below with a silvery down. The erect bran-



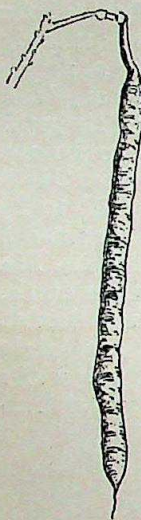
ches and large leaves are distinctive in the Indian Laburnum and quite unlike the feathery, mimosa-like foliage and drooping branches so usual among the Cassia trees.

Few trees in India are more beautiful when in flower. Draped in streaming clusters of bright yellow blossoms, which hang from its branches in a golden shower, the tree suggests the English Laburnum. But it is infinitely more beautiful. Its drooping clusters of flowers are longer and the flowers themselves much larger.

Each raceme or cluster is from 12 to 18 inches long. The cluster is made up of slender, thread-like stalks which hang downwards and



bear a profusion of large, fragrant, yellow flowers. The stalk of a flower is from $1\frac{1}{2}$ to $2\frac{1}{4}$ inches long. It is slender, slightly hairy or quite smooth. The calyx is made of 5 tender green sepals which fold backwards on the stalk. There are 5 petals almost equal in size, almost oval in shape and very distinctly veined. They enclose 10 thread-like stamens all crowned with anthers. The 3 longest stamens are much curled and bear large, oblong anthers. There are 4 smaller median ones which are quite straight, the 3 remaining stamens are quite short and erect. Their anthers do not bear pollen. The pods of which there is always a great profusion are very conspicuous during leaf fall. They hang like so many straight pipes and have given the tree its Latin name of *fistula*. For a similar reason the Dutch, an unromantic people, call our Laburnum the Pudding-Pipe Tree while the Bengalee refers to the pods as 'Monkey Sticks'. The Pod is a straight cylinder. It is from a foot to 3 feet in length, and about an inch in thickness. It is quite smooth and dark green when young, turning dark brown and then black with age. Each pod contains from 40 to a 100 oval, shining, yellowish-brown seeds embedded in a dark coloured, sweetish pulp.



Distribution: Common in deciduous forests throughout the greater part of India and Burma, ascending to 4,000 ft. in the Himalaya; also in Ceylon. The tree is not gregarious, but is scattered in mixed deciduous forests, often of a somewhat open type: it occurs fairly frequently in sal forest. Sometimes it approaches gregariousness in localities frequented by monkeys. It is found on a variety of geological formations and will grow on poor shallow soil, as on the dry outer slopes of the Himalaya. In climatic requirements it shows a wide range. In its natural habitat the absolute maximum shade temperature varies from 100° to 120° F., the absolute minimum from 25° to 65° F., and the normal rainfall from 20 to 120 inches or more.

Leaf-shedding Flowering and Fruiting: The tree is leafless for a very short time, or hardly at all, between March and May, the new leaves appearing in April-May; these are bright green or sometimes a beautiful rich copper colour. The long pendulous racemes of large bright yellow flowers appear chiefly with the new leaves from April to June, but it is no uncommon thing to find the tree in flower even as late as September, particularly in dry years. The long cylindrical pods develop rapidly, reaching almost full length but not full thickness by October, when they are still soft and green. By November they are full-sized but still green and unripe; they commence ripening in December and continue ripening from January till March or April. The ripe pods hang for some time on the tree, commencing to fall about April-May continuing to fall in the following months: old pods may often be found on the trees in September or later along with the new half-grown green pods.



Photo by V. S. de Persone.

The Indian Laburnum (*Cassia fistula*).



Photo by C. McCann.

Flowering Branch of the Indian Laburnum (*Cassia fistula*).

Like many other hard leguminous seeds, those of *Cassia fistula* take some time to germinate, some lying a whole year in the ground before doing so, even if regularly watered. Boiling the seeds for about five minutes before sowing, has been found to give very good results in stimulating germination. Tests carried out at Dehra Dun showed that the seeds retain their vitality unimpaired for at least 2 years. It was found that seed from pods one year old germinated more quickly than that from fresh pods, though the percentage of sound seeds in the former may be low owing to insect attacks. (Ex Troup.)

Gardening : *C. fistula* stands a moderate amount of shade. It is not frost-hardy, and suffered severely in the great frost of 1905 in Northern India. In the abnormal drought of 1907 and 1908, which seriously affected the forests of Oudh, it proved to be decidedly hardy. It is not readily browsed, even by goats. It coppices vigorously and produces root-suckers from a root-system which is partly superficial. As already stated, it is not exacting as regards soil, and may be found on poor shallow soils.

Natural reproduction : The following facts have been established regarding the natural reproduction of this tree from seed :

1. Reproduction is effected mainly, and perhaps entirely, through the agency of animals (monkeys, jackals, bears, pigs, and possibly others), which break open the pods to eat the pulp and thus scatter the seeds or swallow and disseminate them.

2. The seed germinates during the rainy season, some lying dormant until the second or even the third rains.

3. Germination is favoured if the seed becomes buried, and to some extent if it is protected by a moderate growth of grass ; if the seed lies on the surface of the ground, much mortality takes place during germination owing to the destruction of the radicle by birds and insects, or to its drying up if exposed to the sun.

4. Many seedlings perish in heavy weed-growth owing to damping off during the rains.

Artificial reproduction : The seed germinates tardily, that kept for a year germinating more readily than fresh seed. The seed should be sown in seed-beds in drills about 10 inches apart in March or April, and regularly watered ; germination ordinarily takes place early in the rains, though some of the seed may lie dormant until the second year, germinating at different times from March onwards. Transplanting requires some care, but it can be carried out satisfactorily while the plants are still comparatively small during the first rains : basket-planting is the most satisfactory method, the seedlings being transferred to the baskets in the first rains and planted out in the second rains. (Troup.)

Uses : From the stem exudes a red juice which hardens into a gummy substance. This is generally known as *kamarkas*. Its economic uses, if any, are at present unknown to authors on Indian economic science, but it is stated to be astringent. The bark is used in tanning, chiefly along with Terminalia.

Medical Uses : In Hindu medicine the pulp is used as a cathartic ; and the root is also described as a laxative, useful in fever, heart disease, retained excretions, biliousness, etc. In the Makhzan-El-Adwiya, the pulp is described as lenitive, useful for relieving thoracic obstructions and heat of blood, and is a safe aperient for children and women. Externally, it is said to be a good application for gout, rheumatism, etc. The flowers are made into a confection known as *Gul-kand* and viewed as a febrifuge. From 5 to 7 of the powdered seeds are prescribed as an emetic, and the shell of the pod rubbed down with saffron, sugar and rose-water, in difficult parturition. In the Konkan, the juice of the young leaves is used to cure ringworm and allay the irritation caused by the application of the marking-nut juice.

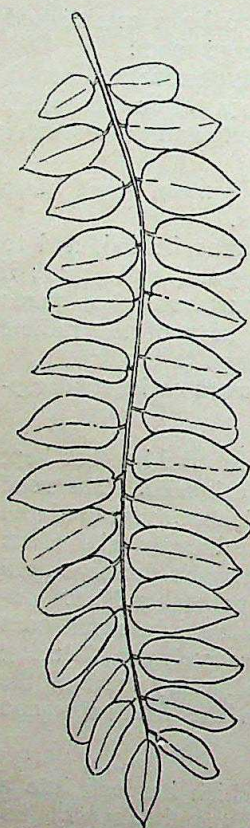
The root is given as a tonic and febrifuge. Dr. Irvine found the root to act as a strong purgative.

It is officinal in the Indian and British Pharmacopœas.

A poultice made of the leaves is said to relieve the chilblains which are common in Upper Sind. It has been beneficially used in facial paralysis and rheumatism when rubbed into the affected parts.

Internally, it is given as a derivative in paralysis and brain affections.

By steam-distilling the finely powdered fruit of *Cassia fistula*, a dark yellow volatile oil, possessing a honey-like odour, is obtained. The oil forms an amorphous mass at ordinary temperatures, melts at 41°C., and has a faint acid reaction. The water which distils over with the oil, contains normal butyric acid.

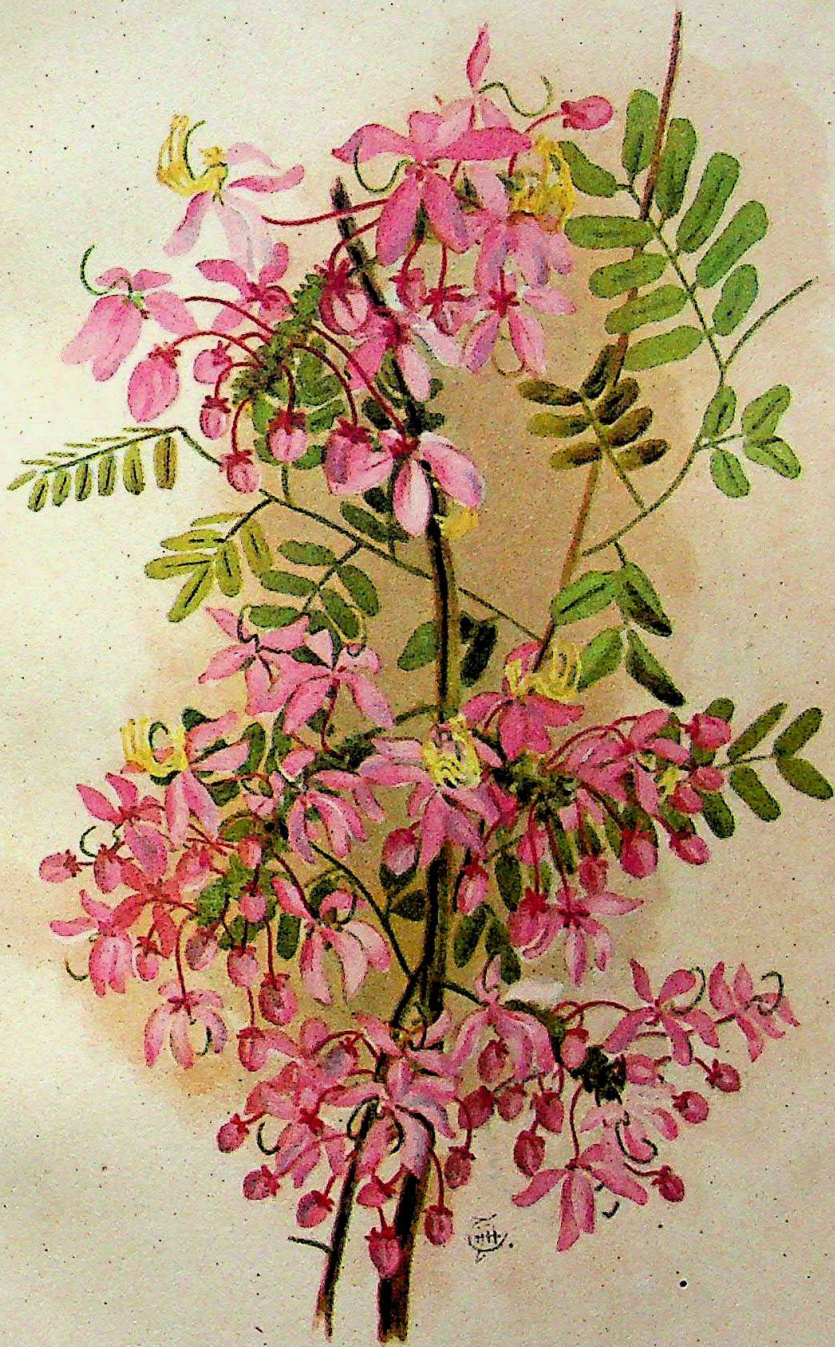


THE BURMESE PINK CASSIA

Popular Names : Burmese Pink Cassia (Engl.); Ngushwe, Ngusat (Burm.).

Cassia renigera Wall., Cat. n. 5307. (*Renigera* means 'kidney-bearing' in allusion to the kidney-shaped stipules.)

Description : A small, medium sized tree growing about 18 to 20 ft. in height. The tree has a short trunk and a few upright branches which bear numerous slender, drooping branchlets. Clothed in feathery leaves, they reach downwards like great spreading plumes. The leaf is abruptly pinnate; there is no terminal leaflet to its main stalk. The young leaves spring from large kidney-shaped stipules which are quickly shed. The leaves grow from 4" to a foot in length. A single leaf is composed of from 8-20 pairs of short-stalked leaflets. They are oblong in shape, rounded at the apex, downy and soft to the touch. Leaf-fall commences during December and by the end of



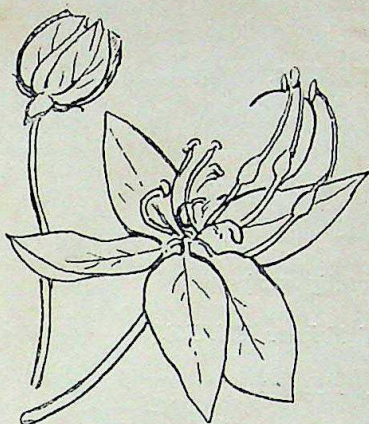
John Bale Sons & Danielsson, Ltd. London

THE BURMESE PINK CASSIA.
Cassia renigera, Wall.
($\frac{1}{2}$ nat. size)



The Burmese Cassia (*Cassia renigera*) flowering in Victoria Gardens, Bombay.

March the tree is practically bare except for a few ragged leaves and the blackened pods which hang from its branches. In April the



first buds appear. These open and in a few weeks the branches are smothered in a gorgeous profusion of pink and white blooms. Young leaves commence to spring up, making an assemblage of tender green leaves and masses of pink flowers which is very striking and beautiful. The flowers are large and showy. The older blooms fade from rose pink to white and give the clusters a variegated appearance. Each dense cluster of flowers is borne upon a short sturdy stem. The clusters arise singly or in pairs above the scars of the fallen

leaves. Each flower-stalk springs from a downy leaf-like bract. These stalks are deep red in colour and covered with fine white hairs. The sepals which make up the calyx of the flower are dull red externally and tender green within. The petals are a deep pink, oblong in shape and nearly an inch in length. As the flowers commence to fade, the tips of the petals turn white, the pink gradually receding and then fading out altogether leaving the flower white. There are ten stamens. The largest 3 are swollen at the centre and much curled and crowned with large tender, green anthers. There are 4 smaller median stamens and 3 quite small erect ones. All of these are capped with anthers. The style is long, thread like and deep red in colour. The pods are very similar to those of the Indian Laburnum. They are quite smooth, cylindrical and grow to 1 foot or 2 feet in length.

Flowering season: The main flowering season is from May to July. Leaf-fall commences during the cold weather and is completed by the end of March and the young leaves sprout in May, shortly after the tree is in full flower. Prain notes that the Shan Hills specimens have yellow flowers.

Distribution: Dry zone of Upper Burma, now introduced into India and the Malay States.

Gardening: The Burma Cassia which is so common in the Bombay City was first introduced by the Hon. Forbes Semphill who sent three plants to Mr. Millard from Rangoon about 1902. When the trees flowered, they were so beautiful that other specimens were obtained and, as the tree seeds quite freely, it has become quite common. The tree has not a long life but it grows rapidly. Trees planted from seed in a garden in Salsette in 1923 bore flowers for the first time in 1929 and in 1930 were about 18 feet in height. The tree is cultivated for ornament. It grows and flowers well even in moist climates like that of Rangoon, Singapore and Bombay although in its natural habitat this Cassia is accustomed to a dry climate and is capable of growing on comparatively poor soil.

(To be continued.)

INDIAN DRAGONFLIES.

BY

F. C. FRASER, LT.-COL., I.M.S., F.E.S.

Part XXXVII.

(With 1 plate and 2 text-figures.)

(Continued from page 738 of Volume XXXIV.)

Sub-family: PLATYSTICTINAE.

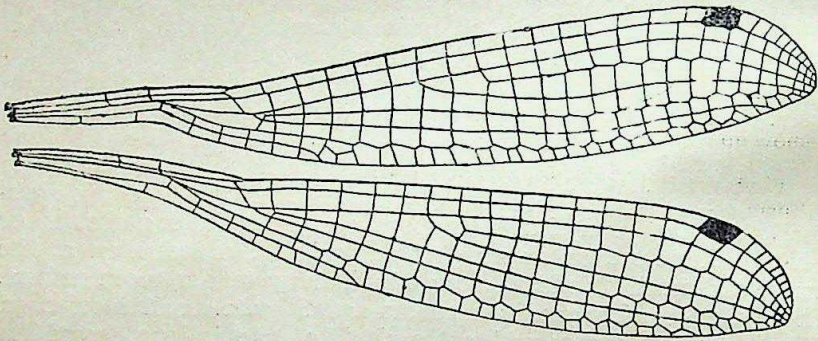


Fig. 1.

Wings of *Protosticta himalaica* Laid.

Genus *Platysticta* Selys. Bull. Acad. Belg. (2) x. p. 436 (1860); Id. *ibid.* pp. 144, 145 (1886).

Legion *Platysticta* Laid. Rec. Ind. Mus. vol. xiii, p. 323 (1917).

Sub-family *Platystictinae* Laid. *Spolia Zeylanica*, vol. xii, pp. 300, 301 (1924).

Dragonflies of small size, coloured black or brown with white markings, or more rarely reddish marked with blue, rarely if ever metallic; resting with wings folded over dorsum; wings very narrow, falcate at apex, hyaline or tipped with black at apices; the nervure *ac* situated midway between the two antenodal nervures; an accessory basal postcostal nervure always present and situated well proximad of *ac*; petiolation beginning well distad of the nervure *ac*; the nervure *ab* reduced or absent and when present, extending from *ac* or the posterior border of wing to the posterior side of the discoidal cell; *IA* absent; *Cvii* markedly reduced, falling well short of middle of wings; discoidal cell elongate, about four times as long as broad, the ends squared; sectors of are arising from the lower end of arc, separate or confluent for a short distance at origin; individual cells mostly four-sided, more rarely five-sided; *Riii* arising well distad of node, nearer node than pterostigma; origin of *R4+5* variable, either slightly proximad, at, or slightly distal of the oblique nervure descending from the subnode; pterostigma short and broad, its costal side usually shorter than the posterior, its inner or proximal side oblique, its distal straight or slightly rounded; no intercalated sectors present except *IRii*.

Abdomen of great length and very slender; in some genera twice or more than twice the length of hindwing, the relative lengths of segments 8, 9 and 10 variable in individual species; anal appendages of male complex, variable in

the species, the superiors usually forcipate and often chelate at the apices or spatulate; inferior appendages more simplified, usually tapering to a point but spatulate in others. Vulvar scales very robust, extending beyond end of abdomen in most species and with a robust dorsal spine-like protuberance before the apex. Penile organ variable, with or without a frill or ridge on the dorsum, the end curling strongly over the stem which its terminal branches embrace.

Larvæ slender, cylindrical, furnished with three triquetral gills, mask flat, subquadrate, Gomphine-like, without setae, middle lobe cleft, lateral lobe robust, furnished with a long moveable hook, legs long and slim, breeding in torrential montane streams or seepages on the sides of hills in dense virgin jungle.

Distribution.—Tropical and neotropical. Within our limits, from Ceylon, Western Ghats, Northwestern India and Burma, in submontane and montane tracts, rarely at sea-level. Species are found haunting the banks of mountain streams of small size, often a mere trickle over rocks or a chain of pools below a spring on a steep jungly hillside in dense shade. Many species inhabit small caves among boulders and rocks beside streams where they exist in a perpetual twilight. In flight they are much given to hovering with the long attenuated abdomen held stiffly and horizontally out, whilst the insect advances or retires in a series of short jerky movements and, if approached head on, will retire backwards instead of reversing and heading off, this backward flying seeming to be accomplished as easily as the forward movement. Owing to their dull colouring, small size and dark surroundings, they are remarkably inconspicuous during flight and would be invisible were it not for the chain of white and blue spots on the abdomen seen to be moving stealthily about the dark recesses. The vivid blue identification marks on the terminal segments of the abdomen show up with remarkable conspicuousness even in the darkest retreats when the insect is at rest.

Ceylon is remarkably rich in *Platystictas*, whilst Continental India and Burma is equally rich in *Protostictas* and *Drepanostictas*.

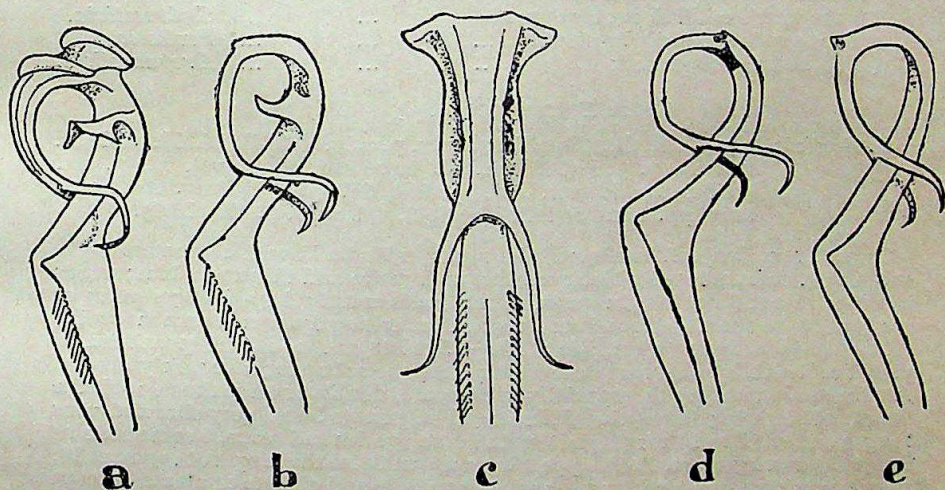


Fig. 2. Penile organs of,—

- a. *Platysticta deccanensis* (Laid.).
- b. *Ceylonosticta hilaris* (Selys.).
- c. *Platysticta maculata* (Selys.).
- d. *Drepanosticta carmichaeli* (Laid.).
- e. *Protosticta gravelii* (Laid.).

Figure a shows the dorsal frill in the dorso-lateral position; figure b the same in profile, figure c the penile organ viewed dorsally, whilst the two remaining figures show the organs viewed from the side; note the absence of the dorsal frill in these.

The former group are sharply separated from the Indian forms by the penile organ which possesses a ridge on its dorsum, absent in the two latter groups, and I have employed this character as a means of classifying an otherwise difficult group of insects. Selys classed the whole of the Ceylon species as *Platysticta* and divided these into two subgenera from venational characters. To the first subgenus a south Indian species has to be added, whilst the second subgenus has been incorporated by Dr. Laidlaw in his genus *Drepanosticta*. The penile organ of this subgenus, so far as the Ceylon forms goes, differs from that of the Indian forms, which furnish the genotype and it is therefore clear that the two groups are not congeneric, although venationally they agree. This being the case I have here retained Laidlaw's genus *Drepanosticta* for the Indian species and have created a new genus *Ceylonosticta* for the Ceylon forms which possess *Drepanosticta* venation. The chain of evolution is probably *Protosticta*, *Drepanosticta*, *Ceylonosticta* and finally *Platysticta*, or the two latter genera may have evolved independently from *Protosticta* and on parallel lines to *Drepanosticta*.

The enormous length of the abdomen of these insects and the complex nature of the anal appendages, admirably adapted as they are for obtaining an enormous grip of the female prothorax, are probably coordinated with the function of oviposition, and I surmise that they enable the male to lower its mate into the swiftly flowing current of the streams they frequent, without fear of it being swept away. (See Fig. 2 Plate.)

Key to the Indian genera of *Platystictine*.

- | | | | |
|---|---|---|------------------------|
| 1 | { | Ceylon forms ; penis with ridge on dorsum simulating a dorsal spine as seen in profile | 2. |
| | { | Indian and Burmese forms ; penis without ridge on dorsum | 3. |
| 2 | { | Sectors of arc separate and divergent from origin ; the nervure <i>IRiii</i> zigzagged almost from origin ... | <i>Platysticta</i> . |
| | { | Sectors confluent at and for some distance from origin ; the nervure <i>IRiii</i> not zigzagged ... | <i>Ceylonosticta</i> . |
| 3 | { | The nervure <i>ab</i> entirely absent | <i>Protosticta</i> . |
| | { | The nervure <i>ab</i> present | <i>Drepanosticta</i> . |

Genus PROTOSTICTA Selys (1885)

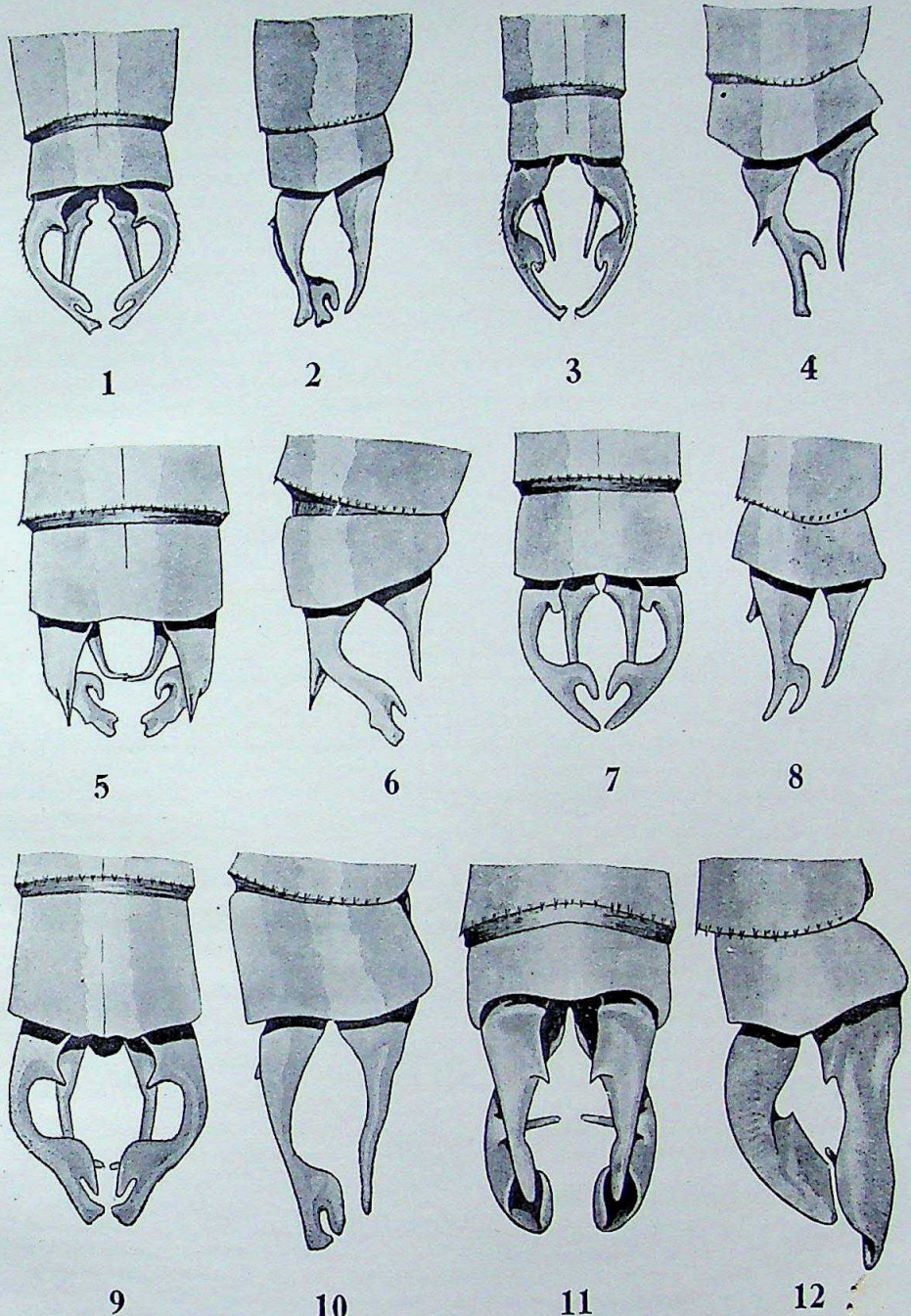
Protosticta Selys, C. R. Soc. Ent. Belg. xxix. p. cxlv, (1835); Id. Mem. Cour. xxxviii, p. 157 (1886); Laid. Rec. Ind. Mus. vol. xi, p. 391 (1915); Id. ibid. vol. xiii, pp. 339, 342 (1917); Fras. ibid. vol. xxiv, pp. 4 and 5 (1922); Id. ibid. vol. xxvi, p. 499 (1924).

Zygopterous dragonflies of small size and slender build with characters of the subfamily, coloured steely black marked with white and turquoise blue; wings hyaline, immaculate, long, narrow, falcate, cells mostly four-sided; sectors of arc fused for a short distance from origin, thus arising from a common stalk; *IRiii* straight, never zigzagged; *R4+5* arising at or a little proximad or distad of the oblique nervure descending from the subnode; *ab* entirely absent. Abdomen of great length, especially in the male, double or more than double the length of hindwing (excepting *P. hearseyi*), segments 3 to 7 very slim and very long, segments 8 to 10 varying in length in the species and sexes, 9 sometimes as long as 8, 10 very short. Anal appendages about twice the length of segment 10, angulated downward and inwards at their middle and chelate at apices (except in *P. himalaica* and *P. uncatius* which are spatulate), inferiors simple, broad at base, tapering thereafter to a fine point, incurved or not. Vulvar scale as for sub-family. Larvæ as for sub-family but only those of *P. gravelyi* and *P. mortoni* known).

Genotype.—*Protosticta simplicinervis* Selys.

Distribution.—The Western Ghats of India from sea-level to 4,000 ft. and North-East India and Burma from 3,000 to 6,000 ft. Habits those of the sub-family; see also under species.

Species of this genus are remarkably local in distribution and in some cases have been found confined to one spot for years, streams close by, never rendering a single specimen; this may be explained by their weak flight, although, some at least, *P. mortoni* and *P. gravelyi*, do wander afar from their habitats.



Explanation of Plate.

1. Anal appendages of *Protosticta hearseyi* Fraser, dorsal view.
2. The same seen from the right side.
3. The same of *Protosticta mortoni* Fraser, dorsal view.
4. The same seen from the right side.
5. The same of *Protosticta sanguinostigma* Fraser, dorsal view.
6. The same seen from the right side.
7. The same of *Protosticta gravellyi* Laidlaw, dorsal view.
8. The same seen from the right side.
9. The same of *Protosticta davenporti* sp. nov., dorsal view.
10. The same seen from the right side.
11. The same of *Protosticta himalaica* Laidlaw, dorsal view.
12. The same seen from the right side.

Camera lucida studies all drawings the same scale.

Col. F. Wall has taken one species at light and I have on several occasions found specimens hovering about the windscreen of my car or actually coming inside. On one occasion I took a male in my bungalow, but this may have come to light the night before. As a rule though, species form definite and lasting colonies, restricted to small districts or even streams.

Key to species of genus *Protosticta*.

- | | | |
|---|--|----------------------------|
| 1 | Small species with ground colouring cupreous and abdomen of both sexes considerably less than 40 mm. in length; male and female of the same length ... | <i>P. hearseyi</i> . |
| | Larger species with ground colouring steely black and abdomen more than 40 mm. in length; male always considerably longer than the female ... | 2. |
| 2 | Pterostigma in both sexes blood red ... | <i>P. sanguinostigma</i> . |
| | Pterostigma in both sexes black ... | 3. |
| 3 | Superior anal appendages chelate at apex ... | 4. |
| | Superior anal appendages spatulate at apex ... | 6. |
| | Basal half of segment 8 pale blue with the middorsal carina finely black; superior anal appendages with the claw-like arms narrow and of subequal length ... | <i>P. gravellyi</i> . |
| 4 | Basal half of segment 8 pale blue, the middorsal carina not marked with black; superior anal appendages varying as shown below ... | 5. |
| | Outer fork of superior anal appendages thickened, obtuse at apex and but slightly longer than the inner ... | <i>P. davanporti</i> . |
| 5 | Outer fork of superior anal appendages very narrow, and nearly four times the length of inner ... | <i>P. mortonie</i> . |
| | Inferior anal appendages with a long finger-like medial spine directed inwards ... | <i>P. himalaica</i> . |
| 6 | Inferior anal appendages without an inner spine ... | <i>P. uncatius</i> . |

Protosticta gravellyi Laidlaw.

Protosticta gravellyi Laid. Rec. Ind. Mus. xi, vol. pp. 389, 390, text-fig. 2. (1915); Id. *ibid.* vol. xiii, p. 342 (1917); Fras. *ibid.* vol. xvi, p. 499 (1924).

Protosticta stevensi Fras. Rec. Ind. Mus. vol. xxiv, pp. 7 and 8. Pl. 1, figs. 1, 2 and 7 (1923); Id. *ibid.* vol. xxvi, p. 499 (1924).

Male. Abdomen 46-49 mm. Hindwing 20-22 mm.

Head, labium brownish black; labrum turquoise blue, rather broadly bordered with black along its free margin; clypeus pale turquoise blue; frons, vertex and occiput glossy black; eyes dark bottle green paling to pale greenish beneath.

Prothorax creamy white marked dorsally with a broad black triangle with its base occupying the greater part of posterior lobe and its apex tapering to the middle of the mid lobe.

Thorax steely glossy black marked with a broad oblique creamy white stripe on each side extending to the middle pair of legs, and a similar stripe on the posterior part of metepimeron extending on to the hinder pair of legs. Beneath marked with broad black stripes on each side which converge and fuse anteriorly.

Legs creamy white, the knees darker. Hind pair of femora occasionally marked on the extensor surface with a brown stripe.

Wings hyaline; 13-14 postnodal nervures to forewings, 12-13 in the hind; pterostigma black, nearly half as long again as broad, the costal side shorter than the posterior, outer border nearly straight, inner oblique; *R* 4 + 5 arising slightly or well distad of the level of subnode.

Abdomen black marked with white and turquoise blue as follows,—segments 1 and 2 white laterally, segment 3 with a narrow basal annule finely divided with black on the dorsum, segments 4 to 7 with broad basal annules gradually broadening as far as 7 and partially divided on the middorsal carina by the

ground colour, segment 8 with nearly its basal half turquoise blue, this extending apicad on the sides and ventrally but divided along the middorsal carina by a fine black line, segments 9 and 10 unmarked. Segment 9 double the length of 10, and 8 double the length of 9.

Anal appendages black (figures 7 and 8 Pl.) Superiors forcipate, chelate, half as long again as segment 10, broad at base where they are furnished with an inner and dorsal blunt rounded tooth, then tapering, but again expanded at the apical half into a 'finger-and-thumb' like structure, the finger process being a little longer than the thumb. Inferior appendages about three-fourths the length of superiors, broad and conical at base, then tapering rather rapidly to apex, furnished with an inner stout spine at base.

Female. Abdomen 33-35 mm. Hindwing 19-23 mm.

Very similar to the male but shorter and more robustly built, differs as follows,—black bordering of labrum broader; eyes, in the living state with a diffuse white spot on the outer sides; wings with 13-14 postnodal nervures to all wings. Abdomen shorter and stouter, especially from segment 7 to the anal end, the former segment nearly three times as long as 8, which is itself actually shorter than segment 9, the latter segment being three times the length of segment 10. The basal annule on segment 7 occupying only about one-fifth the length of segment and often interrupted on the dorsum, whilst 8 is unmarked save for a large white spot situated at the base on each side; segments 9 and 10 immaculate but the former sometimes with a large lateral white spot. Anal appendages black, barely as long as segment 10, broad, conical, pointed at apex.

Distribution.—This species is the most widely distributed of all the Protostictas and occurs in many ravines from 2,000 to 4,000 ft. in many parts of the Western Ghats. It occurs in the Nilgiri Hills on both sides of the plateau, at Kallar, Burliyar and Gudalur, from May to June. In Malabar and Cochin it occurs in the Vayitri, Nilambur and Kavalai Ghats from May to June and again in September and October. It may be found lurking amongst rocks and ferns or in the dark tunnels formed by trees and shrubs overhanging torrential beds. In flight it holds its abdomen rigidly horizontal and advances in short jerks on its objective or reverses and flies backwards with equal ease, and is visible in the prevailing gloom only by the chain of white dots marking the bases of the segments. Type in Indian Museum, paratypes in British Museum, etc.

Some confusion has arisen over this species probably due to the fact that the type is immature and in very poor condition, with its abdomen crumpled up and appendages distorted. The marking on segment 8 has been given as that for 7, and the length of the abdomen has been given as that for the body. It was due to these excusable errors that *P. stevensi* was described by myself as a separate species. Since then I have had an opportunity of examining the type and female cotype and making new measurements. From this I find that *gravelyi* and *stevensi* are conspecific. Dr. Laidlaw's name having priority. The female I find is really that of *P. mortoni*; it is to be remembered that when Dr. Laidlaw described these sexes, *P. gravelyi* represented the only Indian Protosticta then known, so that it was but natural he should consider the insects as the two sexes of one species, although taken in different localities.

Protosticta davenporti sp. nov.

Male. Abdomen 43-45 mm. Hindwing 23-24 mm.

Very similar to *P. gravelyi* from which it differs however by its much more robust build, this character being very striking when the insects are confronted. It is then seen that although the abdomen of *P. gravelyi* is longer, the head and thorax are of much slighter build and the wings are correspondingly shorter and narrower. The anal appendages although built on the same plan as those of *P. gravelyi*, have very marked differences.

Head, prothorax and thorax similar to *P. gravelyi* but the markings more definitely bluish and the black dorsal marking of the prothorax restricted to the middle portion of the posterior lobe and ending as two points on the dorsum of the mid lobe.

Wings broader and longer; pterostigma black, half as long again as broad, 14-15 postnodal nervures to forewings, 13-14 in the hind. (One specimen is remarkable in possessing four postcostal nervures in one of its wings, instead

of the usual nervure *ac* and one additional postcostal); *R*₄+5 arising opposite the level of subnode.

Abdomen black with the sides of segments 1 and 2 and the base of 3 bluish white; segments 4 to 7 with narrow white basal annules which broaden apicad on the sides; segment 8 with its basal third or half pale turquoise blue, this colour extending nearly to apex of segment laterally, but not divided on the middorsum as in *P. graveleyi*. The blue annule on this segment separated from the extreme base by a narrow triangle of black. Segments 9 and 10 immaculate and of the same relative lengths as in *P. graveleyi*.

Legs differing from the latter species by the femora black, the two hinder pairs white on the extensor surfaces and the middle pair with a large white distal spot at the distal ends on the outer side; tibiae dirty white, tarsus black.

Anal appendages black. (Pl. figs. 9 and 10.) Superiors forcipate, chelate, half as long again as segment 10, broad at base where they present a large inner sub-basal pointed tooth or spine, then narrowing abruptly and expanding again in the distal half to form a 'finger-and-thumb' like structure which differs from that of *P. graveleyi* by the finger process shorter and broader and with its apex broadened and flexed inwards to almost meet the apex of the thumb; outer border of this appendage very sinuous, not gradually curved as in the last species. Inferior appendages broad at base, then tapered gradually to apex, slightly sinuous as seen in profile but with a distinct angulation about the middle as seen from above and with the apical fourth curled rather abruptly inwards; nearly as long as superior appendages.

Distribution.—Confined so far as known to the Annaimallai and Mudis Hills at elevations of about 3,000 to 4,000 ft. and found in similar situations to the last species. The shape of the anal appendages shown in Pl. figs. 9 and 10, will serve to distinguish this fine insect from all other Protostictas. Type in British Museum paratypes in author's collection.

Protosticta sanguinostigma, Fraser.

Protosticta sanguinostigma, Fras. Rec. Ind. Mus. vol. xxiv, pp. 6 and 7, Pl. 1, figs. 5 and 6 (1922); Id. ibid. vol. xxvi, p. 499 (1924).

Protosticta cerinostigma, Fras. (*var.*) Ibid. vol. xxvi, pp. 499, 509 (1924).

Male. Abdomen 42–45 mm. Hindwing 22–26 mm.

Head,—labium yellowish; labrum turquoise blue narrowly bordered with black along the free margin; clypeus turquoise blue; frons, vertex and occiput glossy black, the latter marked with a transverse coppery brown fascia; eyes bottle green, pale greenish blue below, these two colours separated by an equatorial band of blackish brown which crosses the head from above and behind somewhat obliquely.

Prothorax black on dorsum, whitish laterally, the mid lobe marked with a large oval blue spot on each side the middle line.

Thorax glossy steely or bronzed black, pale blue on the sides where a narrow oblique stripe of black bordered with brown traverses the anterior border of the metepimeron. Beneath immaculate, thus contrasting strongly with the two former species.

Legs pale yellow, femora lined with black on extensor surface and with a broad brown annule at the distal ends; tibiae clouded or stippled with brown; tarsi dark brown.

Wings hyaline; pterostigma blood red, covers one cell, of similar shape to the former species; 15–18 postnodal nervures to forewings, 14–15 in the hind; *R*₄+5 arising slightly or well distad of the oblique nervure descending from the subnode.

Abdomen blackish brown on dorsum, paler on the sides, marked with white and pale turquoise blue; segments 1 and 2 white laterally, segments 3 to 6 with broad distal black annules, segment 3 with a very narrow obscure white annule at the base, segments 4 to 7 with broader annules gradually increasing in depth from 4 to 7, segment 8 turquoise blue, its apical border black, this colour continued basad as a gradually narrowing tongue of black along the middorsal carina as far as the base of segment, segments 9 and 10 entirely black. Segment 7 very long and broadening apicad, segment 8 only slightly longer than 9, which is nearly three times the length of 10.

Anal appendages black (Pl. figs. 5 and 6); superiors forcipate, chelate, seen from above appearing only slightly longer than segment 10, but in profile

owing to the ends being bent strongly downward, seen to be nearly twice the length of the segment, very broad at base, then tapering and inclined strongly down and inward to end in the usual 'finger-and-thumb' process, the finger portion much broader and longer than the thumb and notched at its apex which is broad and blunt; the thumb portion curled in to nearly meet the opposing process; dorsally the basal portion continued horizontally back to end in a robust pointed spine. Inferior appendages about three fourths the length of superiors, broad at base, then rapidly tapering to a fine point, the apical fourth angulated strongly inwards to meet or overlap its fellow on the opposite side.

Female. Abdomen 39 mm. Hindwing 26 mm.

Very similar to the male but of much shorter and stouter build, differs as follows,—the equatorial belt of black encircling the eye much better defined; prothorax a dirty white laterally and without the middorsal blue spots. Wings similar to the male, pterostigma blood red; 16-17 postnodal nervures to forewings, 14-15 in the hind, R_4+5 arising at the same level or nearer to the subnode.

Abdomen black marked with white and turquoise blue as follows,—segment 1 with a blue spot on each side, 2 with a lateral blue spot at the base prolonged laterally apicad and ventrad, segment 3 with its middle two-thirds laterally and beneath brownish white, 4 similar and with a narrow whitish basal annule, 5 and 6 with well-marked white basal annules, the ventro-lateral markings more obscure, segment 7 with its basal third turquoise blue, the black not continued basad along the middorsal carina as in the male, remaining segments entirely black.

Anal appendages black, barely as long as segment 10, small, conical, triangular processes. Vulvar scale robust, extending beyond end of abdomen.

Distribution—Nilgiri Hills, Coorg and Malabar Wynaad. Specimens from the two latter districts are much smaller than those from the Nilgiris. In the latter district it is moderately common in the Burliyar ravine, Mettupalayam Ghat at 1,500 ft., but very rare on the opposite side of the plateau, where the variety *cerinogstigma* was found. (Structurally this latter insect does not differ from type so that I consider it to be merely a variety.) In Coorg it is located to Hallery, whilst in the Wynaad, it appears to be restricted to the Vayitri and Nilambur Ghats from May to October. The blood red pterostigma and the shape of the anal appendages, relative lengths of the terminal abdominal segments, etc. will serve to differentiate this beautiful species from all other *Protostictas*. Type in the British Museum.

Protosticta mortonii Fraser.

Protosticta mortonii Fras. Rec. Ind. Mus. vol. xxvi, pp. 500, 501 (1924).

Protosticta gravellyi Laid. (*mortonii* nec *gravellyi*) *ibid*, vol. xiii, p. 342 (Female) (1917).

Male. Abdomen 41-43 mm. Hindwing 20 mm.

Head,—labium blackish brown; labrum turquoise blue moderately broadly bordered with black along its free margin; clypeus turquoise blue; vertex and occiput glossy steely or bronzed black; frons black; eyes ultramine blue capped with black above, paler blue beneath.

Prothorax pale blue except the posterior lobe which is black.

Thorax steely black on dorsum, pale blue laterally, traversed along the postero-lateral suture by a broad black stripe; beneath thorax yellowish marked by two thick black stripes which converge and become confluent anteriorly as in *P. gravellyi*.

Legs white, the knees and femora sparsely stippled with black.

Wings hyaline: pterostigma black framed narrowly in pale brown and this again framed within thick black nervures; 13 postnodal nervures to forewings, 12 in the hind; R_4+5 arising distad the oblique nervure descending from the subnode.

Abdomen black marked with turquoise blue and white as follows,—segment 1 blue laterally, segment 2 with the basal two-thirds of the sides white, 3 with a narrow white basal annule prolonged for a short distance along the sides and narrowly interrupted on the dorsum, segments 4-7 with broad white basal annules occupying about one-sixth the length of segments and prolonged along the sides and ventrum, segment 8 with the basal half turquoise blue but this colour prolonged along the sides nearly as far as the apical end of segment

and separated from the base by a narrow black annule; segments 9 and 10 entirely black. Segment 7 very long, 8 about one-third the length of 7 (In the original description, this segment was given in error as slightly more than one-fourth the length of segment 7, whereas 9 was intended), segment 9 rather more than half the length of 8 and slightly more than twice the length of 10.

Anal appendages black (Pl. figs. 3 and 4); superiors forcipate, chelate, about twice the length of segment 10, broad at base, then constricted and curved downwards and again dilated in the first part of the apical half to form the usual 'finger-and-thumb' process, the finger thrice the length of the thumb and with its extreme end angulated inward, the thumb portion short and stout; dorsally the basal portion ending in a robust pointed tooth or spine very much as seen in *P. sauguinostigma*. Inferior appendages very broad at base, then abruptly narrowed, curled gently in and tapered to a fine point, about three-fourths the length of superiors.

Female. Abdomen 32-33 mm. Hindwing 19-20 mm.

Very similar to the male but much shorter and more robust. Markings differ only on the abdomen where segment 7 has a blue basal annule occupying from one-third to one-fourth the length of segment, and segment 8 has a large basolateral whitish spot on each side, 9 and 10 entirely black. Segment 7 is rather more than four times the length of segment 8, which is itself slightly shorter than segment 9, the latter being nearly four times the length of 10.

Anal appendages very short, barely the length of segment 10, conical pointed, black. Vulvar scale very robust, extending beyond end of abdomen.

Distribution.—Very local, usually found in isolated colonies. The original colony in the Sampaji Ghat, Coorg, was restricted to one part of a tributary of the Sampaji river. Since then I have found other colonies along the foot of the Western Ghats in Malabar and a single female has been taken on Salsette Island by Mr. Prater. The species thus differs from all others by being found at or near sea-level. The colouring of the prothorax forms a ready means of identification whilst the appendages will serve to separate it from all other species. As mentioned above, the female described by Dr. Laidlaw as that of *P. gravelyi*, and which was taken at Talewadi, Castle Rock, Kanara (a locality far removed from that wherein the type of *gravelyi* was found), is really the female of *P. mortoni*. Type in the British Museum.

Protosticta hearseyi Fraser.

Protosticta hearseyi Fras. Rec. Ind. Mus. vol. xxiv, pp. 5 and 6, Pl. 1, figs. 3 and 4 (1922); Id. ibid. vol. xxvi, p. 499 (1924).

Male. Abdomen 30-35 mm. Hindwing 18-21 mm.

Head,—labium ashy white; labrum turquoise blue narrowly bordered with black along the free margin; the two basal joints of antennæ blue; clypeus turquoise blue; frons, vertex and occiput black; eyes olivaceous above, paling and changing to pale blue beneath.

Prothorax pale blue, immaculate (Fading to pale brown in the dry state.)

Thorax cupreous on the dorsum, pale blue laterally, the middorsal carina finely blue, whilst laterally a broad oblique black stripe traverses the length of the postero-lateral suture and anterior part of metepimeron. Beneath whitish marked with a round spot of black between the legs and a pair of short stripes which converge and become nearly confluent with the anterior spot.

Legs bluish white, the two hind femora with narrow blackish transverse lines on the extensor surface; the knees black.

Wings hyaline, pterostigma black, shaped similarly to the rest of the genus, covering one cell; 10-14 postnodal nervures to forewings, 10-12 in the hind; $R_4 + 5$ arising opposite or distad the oblique nervure descending from the subnode.

Abdomen enfumed brown or cupreous marked with pale blue, this colour more in evidence on the final segments. Segments 1 and 2 with the sides bluish white and with a diffuse longitudinal stripe on the middorsum, incomplete on the apical half of 2; segments 3 to 7 with narrow pale basal annules extending more broadly along the sides and with broad black apical annules; segment 8 turquoise blue with a narrow black apical annule; 9 and 10 black,

the former with a bluish crescentic spot on each side. Segment 7 twice the length of segment 8, 8 half as long again as 9 which is more than twice the length of 10.

Anal appendages black (Pl. figs. 1 and 2) about twice the length of segment 10, forcipate, chelate, broad at the base and furnished here with a robust inwardly directed sub-basal spine, then constricted and sub-cylindrical but again slightly expanded at the apical third to form a 'finger-and-thumb' process, the finger portion considerably longer than the thumb and squared at its apex; the whole appendage curving gently in and downwards. Inferior appendages about four-fifths the length of superiors, truncate, broad at base and tapering to a slightly and gently upturned point, the base furnished with a blunt inner tooth and one or two minute teeth thereafter.

Female. Abdomen 32-33 mm. Hindwing 22 mm.

Very similar to the male and approximately of the same length although more robust in build. Differs as follows,—labrum more broadly bordered with black; eyes olivaceous brown above changing to pale green below; middorsal carina of thorax obscurely white at its upper part only. Wings with 12-13 postnodal nervures to forewings, 12 in the hind; $R_4 + 5$ arising at or but slightly distad of the subnode. Segment 7 with a broader basal annule, segment 8 brownish black marked only with a basolateral dirty white quadrate spot, segment 9 paler brown, marked with a broad white spot on each side confluent with a smaller subdorsal spot of the same colour.

Anal appendages black, very small, about equal in length to segment 10, conical, pointed. Vulvar scale robust, extending beyond end of abdomen.

Distribution.—Nilgiri Hills and Annaimallais. The type was taken at a small brook running through a coffee tote on the Gudalur Ghat, in June; out of 17 specimens, only one was a male. A single male was taken later in the neighbouring Ochterlony valley. Recently I found the species in the Mudis, Annaimallai Hills, 3,000 ft. in May, where about 18 males but no females were taken. The locality was a rocky hillside in virgin jungle where a seepage not amounting to a brook found its way down through fern and moss to the river below, and the whole of the specimens were found in an area not covering more than a quarter of an acre; search in neighbouring jungle revealed none. These specimens were in company with *Heliogomphus promelas* which were equally restricted to the spot. Returning a few days later *via* the Nilgiris, I again found *P. hearseyi* in the same spot on the Gudalur Ghat and by a curious coincidence took a number of females and only one male. This curious incidence of the sexes is very difficult to explain. The small size of the species and its cupreous colouring will serve to identify it from all others of the genus. It is the only species in which the two sexes are approximately of the same length.

Protosticta himalaica Laidlaw.

Protosticta himalaica Laid. Rec. Ind. Mus. vol. xiii, pp. 342, 343 (1917).

Protosticta lindgreni Fras. Journ. Bom. Nat. Hist. Soc., vol. xxix, p. 741 (1923); Id. Ibid., vol. xxvii, p. 150, (1920).

Male. Abdomen 40-43 mm. Hindwing 25-26 mm.

Head,—labium pale brown or brownish yellow; labrum turquoise blue narrowly bordered with black along its free margin; clypeus turquoise blue; frons, vertex and occiput steely bronzed black; eyes black above changing to dark olivaceous and finally pale bluish green beneath.

Prothorax black on dorsum and upper part of sides, marked with a broad subdorsal longitudinal creamy yellow stripe on each side extending from the posterior lobe to the anterior end, yellow low down on the sides.

Thorax bronzed black on dorsum, pale blue at the sides which are marked with a moderately broad black oblique stripe extending along the posterolateral suture. Pale blue beneath unmarked with black. Legs pale sandy yellow, extensor surfaces of all femora black.

Wings hyaline, pterostigma dark reddish brown, almost black with a fine frame of light yellow bordering the enclosing nervures within, about one-third longer than broad, costal side only slightly longer than the posterior and the outer side but slightly longer than the inner; $R_4 + 5$ in the forewings arising

very slightly distad the oblique nervure descending from the subnode but opposite that nervure in the hind; 14-16 postnodal nervures in forewings, 13-15 in the hind.

Abdomen blackish brown marked with white and pale blue as follows,—segment 1 bluish at the sides and with a white apical ring, 2 bluish laterally and marked on the dorsum with a bluish longitudinal stripe not extending to the apical border, segment 3 with a small white dorsal basal triangle and a broad apical black annule, segments 4 to 7 with narrow white basal annules, 4 to 6 with broad black apical annules, segment 7 with its apical half, the whole of 8 and 9 pale blue, segment 10 blue at its extreme base, black apicad. Segments 7 to 10 gradually decreasing in length towards the last segment.

Anal appendages about twice the length of segment 10, dark brown (Pl. figs. 11 and 12); superiors broad at base, compressed, with an angulation on the inner side near the middle not amounting to a spine, after which the appendages are curved downward and abruptly broadened into a scoop-like expansion hollowed out on the inner side. Inferiors slightly longer than the superiors, broad at base, then constricted and again broadened and with the edges strongly curled like a drying leaf. A long inwardly directed narrow spine springing from the upper side of this expansion about the middle of appendage.

Female. Abdomen 37 mm. Hindwing 26 mm.

Very similar to the male, differs only in its shorter and more robust abdomen and in some of the markings of this structure. The venro-lateral aspect of segment 3 as well as 1 and 2 are definitely blue, segments 4 to 6 have broader basal annules especially the latter segment, 8 has a large blue spot on each side, whilst 9 and 10 are reddish brown. (Possibly blue in the living state.) Anal appendages small, rather shorter than segment 10, conical, pointed, blackish brown. Vulvar scale robust, extending a little beyond the end of abdomen.

Distribution.—Northern Bengal, Assam and Sikkim at altitudes of 3,000 to 6,000 ft. I have examined specimens from Kalimpong and Pashok and have taken the insect at Moungpoo, Darjeeling district in May and June. Although so widely spread, it does not appear to be nearly as common as some of the South Indian species. Its habits are entirely similar and it is found in similar localities. Abdominal markings and the shape of the anal appendages which are entirely different to the genotype will serve easily to distinguish it from all others. A fresh comparison of the types of *himalaica* and *lindgreni* has convinced me that they are conspecific, the former name having priority.

Protosticta uncatus, sp. nov.

Male. Abdomen 42 mm. Hindwing 21 mm.

Head,—labium pale brown; labrum turquoise blue narrowly bordered with black along the free margin; anteclypeus turquoise blue; postclypeus, frons, vertex and occiput bronzed black; eyes dark olivaceous green, paler below.

Prothorax pale yellow marked with a pair of ill-defined, longitudinal, subdorsal dark brown stripes made up of a row of three spots, the largest of which is situated on the posterior lobe.

Thorax bronzed black on dorsum, pale blue laterally changing to pale yellow beneath, which is unmarked. A narrow oblique black stripe on each side mapping out the postero-lateral suture, and a small upper posthumeral blue spot.

Legs pale yellow, knees darker, hind femora with a black stripe along the extensor surface.

Wings hyaline; pterostigma as broad as long, costal side only slightly longer than posterior, the inner side very oblique, blackish brown framed in black nervures which are lined inwardly with pale yellow; 15-16 postnodal nervures to forewings, 15 in the hind; $R_4 + 5$ well distad of the oblique nervure descending from the subnode.

Abdomen shaded with brown and ringed with blue, white and black as follows,—segment 1 with the sides blue dorsum blackish brown, 2 with the apical half blackish brown, basal half on dorsum warm brown, the sides blue for the basal three-fourths but this colour invaded by the brown of dorsum at its middle, segments 3 to 6 with broad basal pale bluish white annules and equally broad apical black annules, the intervening part warm brown, 7 with

only the basal annule, the rest brown gradually deepening to black at apex, 8 black with a small baso-lateral spot on each side, 9 entirely turquoise blue, 10 entirely black. Segment 7 three times as long as 8, which is half as long again as 9, the latter nearly four times as long as 10.

Anal appendages black; superiors as long as segment 10, broad at base, then tapering as far as their middle at which point they are bent down rather abruptly and terminate in an expansion shaped like a parrot's beak. Inferior appendages slightly longer, broad at base, spatulate, compressed and furnished at the apex with a tuft of about 10 to 12 stout bristles.

Female. Abdomen 35 mm. Hindwing 21 mm.

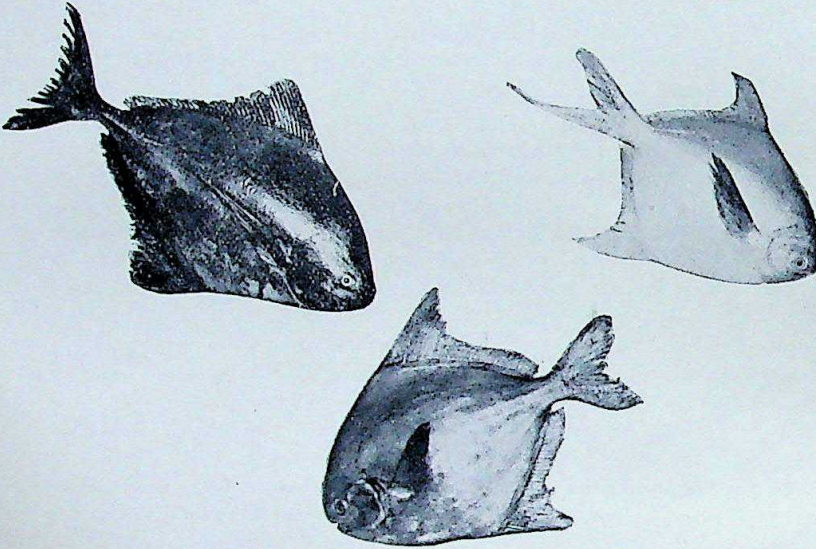
Closely similar to the male save for its sexual characters and the slightly shorter and more robust abdomen. Markings of head, thorax and abdomen not differing markedly from the male but segment 9 has a narrow basal black annule and the sides low down dark brown. Wings similar, 15 to 16 postnodal nervures in forewings, 15 in the hind.

Anal appendages very short, not quite as long as segment 10, conical, pointed, blackish brown. Vulvar scale robust, extending beyond end of abdomen.

Distribution.—Maymyo and Gokteik, South Shan States. One male and two females collected by Col. F. Wall, I.M.S., during the early part of June. The species is remarkable for its anal appendages, which like those of *P. himalaica* differ markedly from those of the genotype. The situation of the 'recognition' mark on segment 9 instead of 8 is also quite at variance with other species of the genus. These specimens were taken at light but should the habitat of the insect be discovered, it will probably prove to be similar to that of other species and the species itself equally common.

(To be continued.)

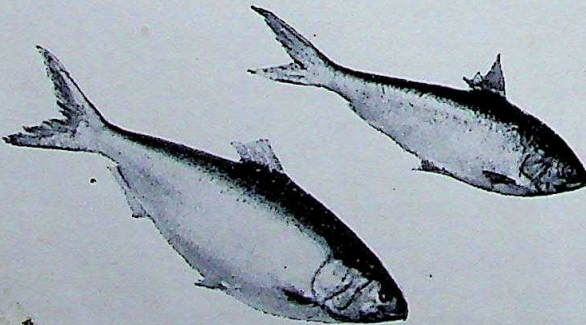
BOMBAY FOOD FISHES.



POMFRETS.

Black Pomfret (*S. niger*). Silver Pomfret (*S. cinereus*).
White Pomfret (*S. sinensis*).

SARDINES.



Pala (*Clupea ilisha*).

THE FISH SUPPLY OF THE WEST COAST OF INDIA.

BY

SIR REGINALD SPENCE, Kt., M.L.C., F.Z.S. AND S. H. PRATER,
M.L.C., C.M.Z.S.

PART II

(With five plates).

(Continued from page 991 of Vol. XXXIV.)

ESTUARY AND 'INSHORE' FISHING.

There are various other fishes commonly obtained in our creeks and estuaries on the sustained supply of which the Industry, not to say the consumer, is actually dependent. Our coastal waters hold a number of resident and migratory fish which are of economic value. Among the larger resident species are the Grey Rock Perch (*Chrysophrys datnia*) known locally as the *Kharwad*, a Cat-Fish (*Arius falcarius*), Grey Mullet (*Mugil aur*, *beorneensis*, *waigiensis* and *dussumieri*). *M. waigiensis* is abundant in the creeks during the rainy season. *M. poicilus* is abundant during the cold weather. All of these are excellent table-fish. They visit quiet bays and also our docks and wet basins where they are fished for by men and boys from the dock-walls. The larger Mullet (*M. poicilus*, *M. aur* and *M. waigiensis*) known as *Boi* or *Pilsa* range from 3 lbs. to 100 lbs. in weight, their retail price varies from As. 12 to Rs. 1-4 each or As. 4 to As. 6 per lb. The season is July to November.

The Lady Fish (*Sillago sihana*) known locally as *Murdi* is common in our creeks. Its flesh is recommended to ladies just in or just out of an 'interesting condition'! Small perch-like fish (*Therapon*) are also abundant. They live easily in fresh water and are often placed in wells. *Therapon jarbua* is very common. It is known locally as the *Khargota*. Other species seen in the Bombay market are *T. quadrilineatus* and *T. theraps*. Gobies occur in numbers. Amongst these *Gobius ocellatus*, the *Kharba*, is the commonest. Other species from the Society's collection taken in the Bombay market are *Gobius macrostoma*, *viridipunctatus*, *masoni*, *striatus*, *ornatus* and *giurus*. Besides these resident species, there are a number of migratory forms which visit the creeks and estuaries in the season. In June, July and August the Cock-up (*Lates calcarifer*), known locally as the *Kajura*, is taken at the entrance of creeks which they enter with the rising tide. They come up the creeks in search of their favourite food, the Niwtas (*Boleophthalmus* and *Periophthalmus*), which live in thousands on the mud banks where their slippery movements can be watched when the tide has receded. Many species of estuary fish come up the creeks not only for food but also for spawning, the main season for which is during the

monsoon. Sea-fishing is then at its lowest and the energies of the fishermen are concentrated upon these fishes to the great destruction of enormous numbers of fry.

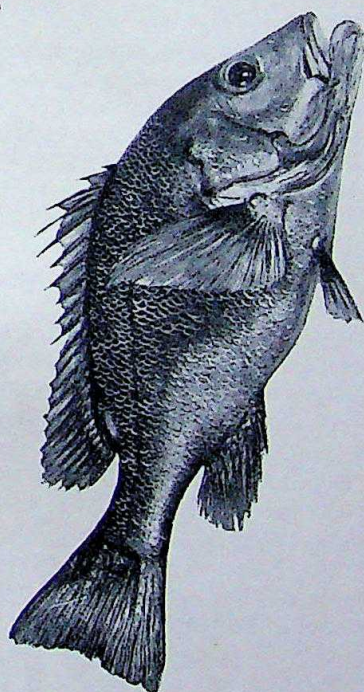
Among the larger migratory fish are three species of Bhamin, *Polynemus tetradactylus*, known, according to Wallinger, to the Kolaba fishermen as the *Chola* (young) and the *Dara* (adult), *Polynemus plebius*, known as the *Rawas* and *P. heptadactylus* known as the *Shendwa*, and a large *Sciæna*, the *Gholmasa* (*Sciæna sina*). Examples of this fish quite 6 feet in length are brought to the Bombay market.

The numerous creeks and inlets of the upper waters of Bombay harbour and of the Konkan coast line are a particularly good haunt for the various species of *Polynemus*. The creeks are full of shrimps and prawns and the fry of several sorts of estuary fish from which these voracious monsters take heavy toll. Bhamin (*P. tetradactylus*) and Rawas (*P. plebius*) work up the creeks in shoals with the rising tide and rush back to sea as it recedes. In the smaller creeks they are netted at high tide; in the more open water of the harbour at ebb. In Bombay the best months are June, July, August and September; the worse the weather, the better the day. In the creeks, Rawas and Bhamin are caught in drift or trammel nets called *Jal*. A large *Jal* is about 165 feet in length by 10 feet in depth. The top of the net has floats hung 5 feet apart, the bottom is weighted. The weights vary according to the nature of the fish which is intended to be caught—for *Lates calcarifer* (Cock-up), which are ground-feeders, the net is heavily weighted so that the bottom touches the ground—for *Rawas* less weight is used so that the net makes a floating wall near to the surface. When used with a boat, the *Jal* acts as a drift net but in creeks the two ends of the net are anchored. 'Bhamin' and *Rawas* when ascending a creek to spawn, take a more or less definite path. It is not at the deepest part nor is it the shortest way across. The path taken by the fish are known to fishermen who set their nets accordingly.

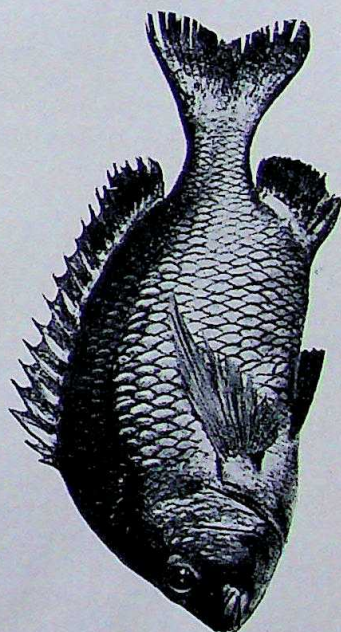
Other species taken in the creeks are *Lutianus johnii* (Tamb) and a horse-mackerel (*Caranx nigripennis*). Gar fish are abundant in season, the commonest species is *Bellone strongylurus* (Toli, Tolka and Tol). Gar fish are long pike-like fish with tapering, well-armed jaws. They are surface feeders lying almost stationary about piles of rocks or by the walls of piers in a good tideway and flashing out at passing prey. The Cat-fishes are represented by *Plotosus canius* (Kalamb), the Crocodile fish by *Platycephalus scaber* (Shatira). Other species which visit the creeks and estuaries in numbers are *Trachinotus russelli* (Nalbi and Dangul) one of the *Carangidae*. A sole (*Pseudorhombus javanicus*) known as the Rhepta or Shivra and the Warra (*Scatlophagus argus*) which is as flat as a pomfret and heavily marked with black blotches. The smaller migratory forms which are taken in large numbers along the coast are Anchovies (*Engraulis taty* and *mystax*), known as Palkati and Taikati. Ribbon fish (*Trichiurus savala*) to which we have already referred; they are known locally as Wakti. Silver-Bellies, mainly *Gerres lucidus* (Muigan), *Equula brevirostris* (Surgutta) which grow to a foot in

BOMBAY FOOD FISHES.

PERCHES.



Rosy Perch (Tamb) : *Lutianus argentimaculatus*.



Black Sea Bream (Palu) : *Chrysophrys berda*.



Cock-Up (Kajura) : *Lates calcarifer*.



Rock-Perch (Vekru) : *Serranus sp.*



Speckled Perch (*Lutianus rivulatus*).

length, and Sardines (*Clupea lile*). Prawns and crabs are taken in enormous numbers.

As stated previously no statistics of the quantities or the value of the various species of fishes sold along the Bombay coast are available. The Fishery Department of the Madras Government has set an example to the rest of India as to what can be achieved in the way of obtaining information about the quantities in which the various marketable fishes are obtained and the economic value of these species. We know nothing of the annual yield of the Bombay Fisheries and we know still less about the life histories of the food fishes of our coastal waters. These are subjects which present an enormously interesting and profitable field of enquiry and subjects which come definitely within the province of a Department of Fisheries which unfortunately does not exist in Bombay.

FISHING GROUNDS

As regards Fishing Grounds we learn from the Report that 'the Gulf of Kutch gave the highest catch per hour of all fish together (145 lbs.) and the conclusion may be drawn that this area, at least in the season when the samples were taken, holds a good stock of trawl-fish. But the position of undesirable snags in the form of coral reefs requires investigation to ensure against the possibility of the losses outweighing the gains.'

'All the grounds except the inadequately sampled Southern Grounds and the Gulf of Cambay (off Daman) show a catch per hour of over 100 lbs. The general mean may be taken as not less than 1 cwt. of fish per hour, as it should be borne in mind that the data from which the figures are calculated are the weights of the several sorts of fish as observed at sea which were in general below, and in some cases considerably below, the actual weight of the total fish caught.'

'The Southern Grounds make a poor showing. Our work here was very limited, and it is likely that the figures are in deficit of average conditions, for we know from the coastal fishings that fish are to be found in abundance on these coasts at certain times of the year. The probability is that they move in shoals and shift their grounds suddenly. Further trawling trails might throw sufficient light on their movements to enable one to pursue the fishing with successful results.'

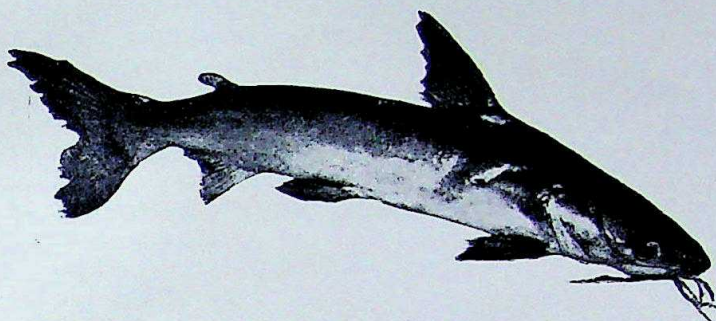
'Considering the more important individual species, the Sind and Gulf of Kutch grounds give the highest figures for Goal. The Kathiawar Grounds and the Gulf of Kutch show the best average yield of Pomfret. The West Coast of Kathiawar, Gulf of Kutch and Sind Grounds show a marked predominance of "Karel" and there seems no doubt but that this species has its maximum density of distribution to the northward. "Wam" are clearly most abundant on the muddy grounds adjacent to Bombay, while "Shingala" are shown to be in general distribution though the highest rate of catch is given by the four hauls in the Gulf of Kutch. Rays (wagli) appear to be most abundant on the Bombay Grounds and off South Kathiawar and are conspicuously less in evidence on the cleaner

grounds off Sind where also the *Wam*, which is a characteristic inhabitant of muddy grounds, is similarly lacking. The shark-like species are shown in greatest abundance off Kathiawar (West) and Kutch.

The tables published in the Report point out, Mr. Hefford writes, 'the distinct drop in the quantities of fish caught when the 30 fathoms line is crossed, except in the case of the post-monsoon fishing when the catch of "goal" slightly exceeded and the catch of pomfret and wam in the 30-40 fathom zone—the average depth was however only 33 fathoms—approximately doubled the normal. It may be noted however that these catches were derived from only 10 hauls which are almost all made near the northern limits of the Bombay Grounds. There are not sufficient data for this locality in other seasons for comparison to enable one to judge whether this is a purely seasonal feature or not. There are indications, however, that as one leaves the latitude of Bombay and proceeds towards the Kathiawar coast, there is a tendency for the fish to be found extending further seaward than is the case further south. How far this is connected with the effect of the large rivers Narbudda and Tapti or whether it has to do with the strongly moving tides of the Gulf of Cambay, are interesting questions which need not be further pursued here. All that can be concluded from the data we have been able to gather, is that in general the heaviest catches of fish made by the trawler were made in the neighbourhood of the 20 fathoms line. Occasionally, unusually good catches were made near or below 10 fathoms on the one hand and in the neighbourhood of 30 fathoms on the other hand. But for all-round fishing the middle depth of 20 fathoms seems preferable. It may be mentioned too that near this contour the grounds appear to be most free from obstructions liable to cause damage to the trawl. Near 10 fathoms there is more liability to meet with rocks, wreckage or such snags as old fishing-stakes, and moreover foul hauls, through the otter-boards overriding the wings of the trawl in shooting, are especially liable to occur in shallow water. Beyond 30 fathoms depth the risk of encountering coral is considerably increased.'

Mr. Hefford's conclusions are that in the case of 'Goal' it would appear their maximum density of distribution lies inside the 20 fathoms line, though at the end of December they were found in abundance up to 36 fathoms about 60 miles NW $\frac{1}{2}$ W from Kundari. In that same neighbourhood and at about the same time pomfrets also appeared in more than normal abundance, in contrast with their tendency during the Pre-monsoon and monsoon seasons to show in greater abundance on the landward side of the 20th fathoms line. The results indicate for 'Karel' an off-shore tendency during the Pre-monsoon months and an in-shore concentration in the monsoon and after. 'Ravas' are clearly revealed as shore-hugging fish except in the post-monsoon when *Polynemus indicus* no less than 'Goal' and pomfret were found in the northern half of the stretch between Bombay and Diu to be distributed in depths which were greater than those which afford their normal habitat elsewhere. The same applies to 'Wam' which, however, show a very distinct aggregation in the vicinity of the 20 fathom line—

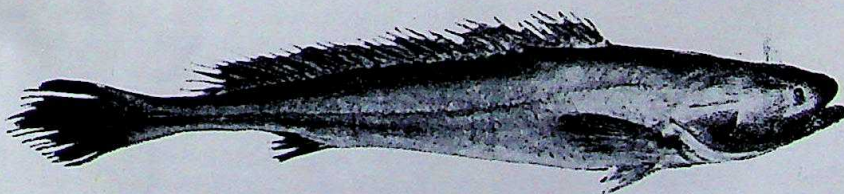
BOMBAY FOOD FISHES.



Cat-Fish (*Singhala*): *Arius dussumieri*.



Bombay Duck (*Bombil*): *Harpodon nehereus*.



Indian Haddock (*Dori*): *Sciænoides brunneus*.

THE FISH SUPPLY OF THE WEST COAST OF INDIA 81

more above than below that depth—in the pre-monsoon month of February. The maximum figure for 'Shingala' is shown for the 20-30 fathom zone in the monsoon season. In other seasons they appear to be more abundant at less than 20 fathoms depth.

'The data from the distant Sind grounds are comparatively scanty and practically limited to the months of December, January and February, but so far as they go they indicate for "Goal" an in-shore concentration in the pre-monsoon month of February. In April and May, one knows from the big local fishery that then takes place, there is a remarkable immigration of "Goal" to the coast in the neighbourhood of Karachi. The figures for "Karel" also appear to indicate a moment to the shallower waters in February.'

'It is a noteworthy fact, though based on only 3 hauls, the average depth of which was 32 fathoms, that the highest catch per hour figures are shown for the 30 to 40 fathom zone in the post-monsoon fishing. The predominant species are goal, pomfret and karel. A comparison is suggested with the similar conditions noted above for the northern Bombay grounds. In each case it seems probable that the neighbourhood of large rivers tends to push out the seaward limits of fish distribution.'

'The data from the South Kathiawar grounds are perhaps too scanty to allow of any very precise conclusions as to variations in bathymetrical or seasonal distribution. It is significant, however, that fairly good catches are shown here for the deeper zones just as was shown by the hauls made in the adjacent grounds of the Bombay area to which reference has been made above. Probably no significance can be attached to the figures for the separate species for comparative purposes, but the indication of a post-monsoon concentration towards shallower water in the case of goal and the relatively high catches of pomfret in the deeper zones at this season may be noted, as well as the increased "Shingala" catches from the 10-20 fathoms zone in the post-monsoon data (derived from the January hauls).'

'The haul which yielded the highest catch per hour of all (of 801 lbs. per hour) was Haul No. 90, the first haul of voyage xi, made on August 19, 1921, at a depth of 15 to 16 fathoms 9 miles west by north from Kundari (Kenri) Island. It is of interest to note the very close proximity of this spot to Bombay. The catch per hour of the different sorts of fish taken in that haul was as follows (expressed in lbs. to the nearest decimal figure):—

Goal	...	...	384.0	lbs.	per	hour
Karel	...	...	213.8	"	"	"
Dori	...	...	101.3	"	"	"
Rays	...	...	42.6	"	"	"
Wam	...	...	24.0	"	"	"
Sharks	...	...	13.3	"	"	"
Shingala	...	...	6.6	"	"	"
Ravas	...	...	4.8	"	"	"
Palu	...	...	4.8	"	"	"
Tambusa	...	...	2.1	"	"	"
Pomfret	...	...	1.3	"	"	"
Chand	...	...	0.8	"	"	"

'Considering individual sorts of fish, the best catch per hour of Goal was 280 lbs. in Haul No. 250 (Voyage xxv, Haul 6) made on the Sind grounds on December 6, 1921, on the northern edge of the Swatch, shooting in more than 50 fathoms and hauling in 17 fathoms at a distance of 52 miles SSE from Cape Monze. The elusive movements or the local concentration of the off-shore shoals of goal—a condition which is well described by the trawler-man's terms "Spotty"—is exemplified by the fact that a second haul, for which the trawl was towed as nearly as possible over the same ground, produced not a single Goal. The haul which produced the second highest catch per hour (209 lbs.) of Goal was also made on the Sind ground, viz., Haul 376 which has been referred to above as yielding the highest total catch of this species. It should be noted that the depth here was 13 to 14 fathoms only. The third highest catch per hour of Goal was 142.9 lbs. made on February 26, 1922, sixty-seven miles SE $\frac{1}{2}$ S from Diu Head (or about 100 miles roughly NW from Bombay) in 20 fathoms. Four other hauls made on the Bombay grounds yielded a catch per hour of over 100 lbs. of Goal. The catch-per-hour figures were 141, 114, 103 and 124 lbs. and the depths 16-15, 15-19, 21-17 and 22 fathoms respectively. The practical conclusion to be drawn from these data is that the best catches of Goal are generally to be made inside the 20 fathoms line.'

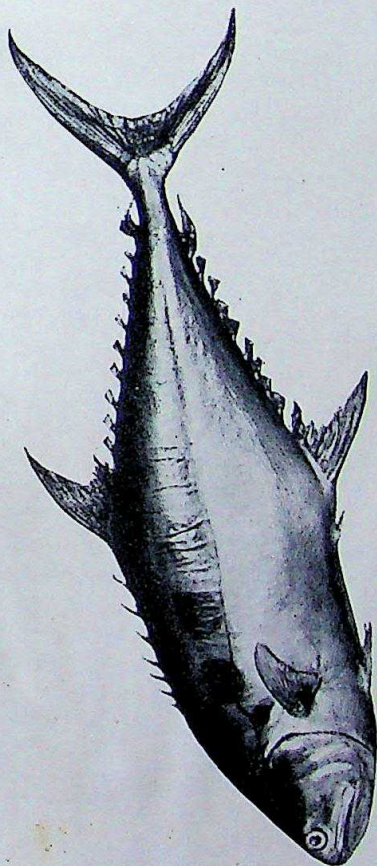
'With regard to the catches of Pomfret, only 10 hauls show catch-per-hour figures which exceed 20 lbs. Two of the above hauls were made on the South Kathiawar grounds and one in close proximity to this region. One was made on the Sind grounds in comparatively shallow water (16-15 fathoms). The optimum depth for the Bombay grounds appears to be a little below 25 fathoms though some good catches were made from tows which were taken at greater depths. Where the depths at the beginning and ending of the tow vary so much as from 24 or 27 fathoms to 40 fathoms, it is of course impossible to say from what of the line the fish were most derived and such hauls are, therefore, of little value as survey data.'

'The voyages which yielded the best catches of Pomfret were Voyage xviii made in October on the grounds abreast of Bombay Harbour, with an average catch-per-hour for the whole fishing time of 20 lbs. of pomfret, Voyage xxii made in November to the grounds in the vicinity of Diu Head (114 to 130 miles NW $\frac{1}{2}$ W from the Prongs Light covering the best of the fishing) with a catch-per-hour of 12 lbs. of pomfret, and Voyage xxxiii made in February on the Bombay grounds when the best catches were made in the area lying between 20 and 25 miles roughly NW by W from Kundari (catch-per-hour of pomfret for whole voyage, 15 lbs.).'

'Regarding the catches of Karel, to sum up the indications as concisely as the data will allow, it may be said that the best average catches were made on the Sind grounds, where the depths above 20 fathoms showed a greater abundance of these fish in the month of December and January, whereas in February the more shallow water inside the 20 fathom gave the better results. On the Bombay grounds there are indications of a concentration of the species for

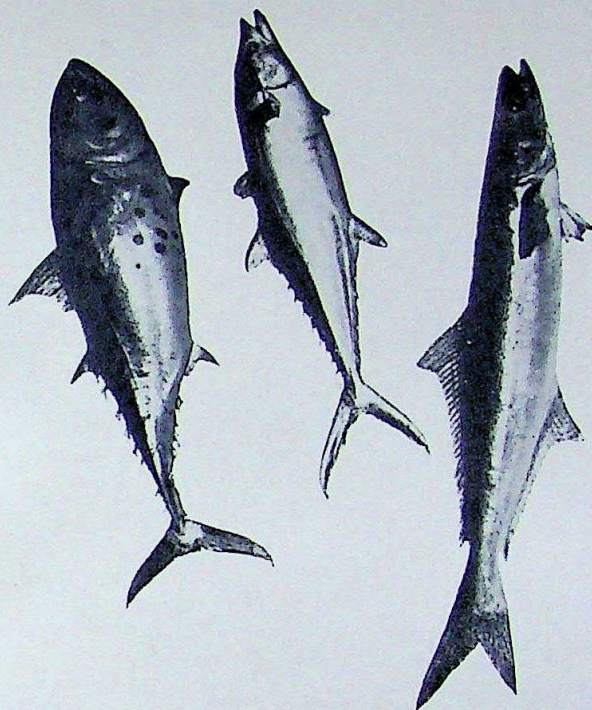
BOMBAY FOOD FISHES.

HORSE MACKEREL



Falai (*Chorinemus tolo*).

MACKERELS.



Tunny (*Cuppa*) : *Thynnus thynnus*.

Seer (*Surnai*) : *Cybium khudii*.

Sakala (*Elacate nigra*.)



Lady Fish (*Murdi*) : *Sillago sihama*.

the monsoon months which seems to be associated with the incidence of spawning.'

CONCLUSION

In 1918 when it was decided to acquire a Steam Trawler to investigate the unknown fishery resources of our local waters, it was resolved at the same time to secure the services of a Marine Biologist to investigate the resources to be exploited. Subsequently a change in the policy required the Marine Biologist to subordinate exploratory work to a new objective—that of catching and landing fish for the Bombay market. The experiment of placing trawl-caught fish on the Bombay market was doubtless an interesting one, but it is obvious that making marketing a primary condition was a handicap to exploratory work at sea. Putting exploitation before exploration was exactly putting the cart before the horse.

The operations of the trawler were not a commercial success; as, at no time did the proceeds from the sales of fish approach anywhere near working expenses. The working expenses averaged Rs. 11,175 per mensem, the monthly receipts from the sales of fish averaged Rs. 2,205. 33 per cent of the working expenses represent wages and 29 per cent coal consumption. Mr. Hefford points out that the pay of the European crew was fixed at a time when the trawling industry was booming in England and wages were at a very high level. The same is to be said about the initial outlay. A Trawler like the *William Carrick* which cost £17,000 in 1920 could have been bought for £7,000 in 1923. Again, expenditure was greatly increased by lengthy, unproductive periods which the trawler spent at sea or in docks. Thus the monthly receipts from the sales of fish caught by the *William Carrick* cannot be taken as a true indication of the commercial possibilities of trawling in our coastal waters. The rate at which fish were caught both in the average and in special seasons is a better guide. The average catch per hour throughout the period of operations works out at 116 lbs. which in Mr. Hefford's opinion could not only be equalled but exceeded by a properly established commercial concern. A commercial fishing trawler could put in at least 20 fishing days a month. The *William Carrick* only approximated this in three out of the 9½ months she was at sea. She landed her catches four times a month, whereas a commercial trawler, as Mr. Hefford indicates, could make as many as ten landings bringing in supplies every third day. Daily landings, although they involve the maintenance of a fleet of 3 or 4 vessels, would provide a yet better chance of commercial success. Mr. Hefford believes that 20 tons of fish is not an excessive estimate of the possible catch of a trawler operating in local waters and he believes that it is safe to assume that a commercial organization would be in a position to obtain 300 per cent better prices than the *William Carrick* could command. He writes: 'The real competition would be not with the local fishermen but with the merchants and vendors in the Bombay markets. A power fishery concern cannot carry on modern methods of production if it is left to the mercy of the fish merchants at Crawford market

to fix the prices it will get for its fish. It must be in a position, at least with a considerable proportion of its supplies, to side-track the middle man and supply direct to the consumer. To do this it must be in a position to guarantee regular supplies. This is most important and this is where a firm working three or four vessels, would have a better chance than a single boat concern.' A smaller trawler than the *William Carrick* would diminish working expenses and coal consumption. Two alternative types are suggested :—a steam drifter equipped with a trawl, Danish seine and drift-nets, or a fleet of fast motor-propelled cutters equipped with seine-nets, etc. So far as Bombay is concerned, Mr. Hefford is of opinion that the type of vessel which would pay best, could only be ascertained after practical demonstration.

The publication of the details of the work carried out by the *William Carrick* are of great practical value as they demonstrate the possibilities of commercial trawling in Bombay waters and provide data as regards the more important economic fishes. It is clear however that a fishery survey of the seas of a Presidency with over 1,000 miles of coast line cannot have been carried out very far over a short period of 9 months.

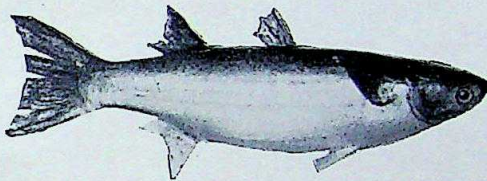
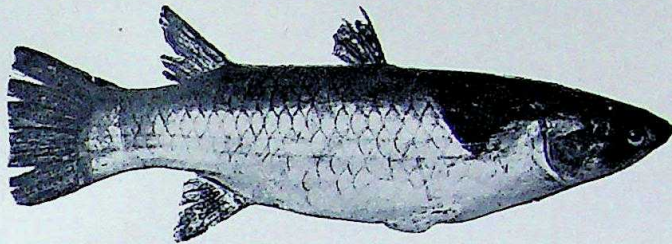
The present prospects of the continuance of fishery investigations are somewhat blank. The posts of Marine Biologist and Assistant Marine Biologist have been abolished. The inconclusive ending of a costly enterprise emphasizes the fact that experiments in this field are fore-doomed to failure unless supported by the practical commercial marketing of fish on the one hand and by scientific investigation on the other. The direction should combine knowledge of local fishing conditions from both the practical and the scientific standpoints.

Power-fishing—not necessarily Steam-Trawling—will some day become one of the great industries of the Bombay Presidency and the present set-back is we believe purely of a temporary nature due to faults in the conception and carrying out of previous schemes.

It is evident that wide local knowledge of the life history and habits of our food fishes is essential to secure success. We must know, at least, the salient facts about our fishes, their breeding seasons, spawning grounds and the main factors controlling their periodic migrations that are the outstanding characteristics of most of our valuable marketable fishes. Knowledge of this description will assuredly enable our sea-fishing industry to develop on modern lines, and so obtain the largest possible quantities of fish in the best condition upon an expenditure low enough to permit of sale at reasonable prices. Successful marketing in Bombay implies low working costs or, in the alternative, greatly increased supplies. Perhaps in no other industry depending directly on the spontaneous produce of Nature, can the possible results so amply repay the capital and labour expended upon it. But the practical Zoologist is essential to success and it is also needful that any extensive steam or motor fishery should have strong and patient financial backing and should be run in conjunction with a well-thought-out and extensive cold storage and distributing agency. It is probably

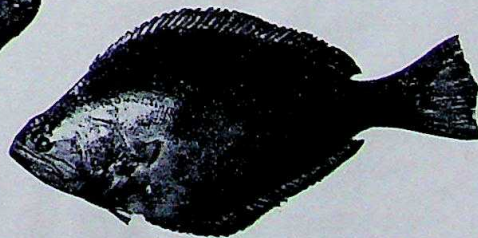
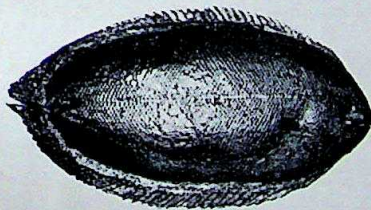
BOMBAY FOOD FISHES.

INDIAN MULLETS.



Hilsa (*Mugil dussumieri*.)
Boi (*Mugil oeur.*)

FLAT FISHES.



Sole (*Synaptura cinerascens.*)
Indian Halibut (*Bakhas*) : *Psettodes erumei*.

easier to catch fish than to dispose of them at remunerative rates. This is not work for a Government Department. Government should confine itself to the investigations needful to supply data essential to commercial success. It is not part of their province to try directly and through their own organization to develop commercially such capitalistic methods of fishing as Steam-trawling. The Steam trawler *Lady Goschen* operated by the Madras Fishery Department is at present engaged purely in investigation and survey. She is not worked with the idea of catching large quantities of fish or landing them at quick intervals and at suitable places for the market. In short, the Madras Fishery Department are not competitors of the fishermen; they are working to obtain information which will put the fishing industry on a better basis.

Extensive cruises along the Malabar Coast have enabled Capt. Cribb, the Skipper of the trawler *Lady Goschen* to obtain a general idea of the South-West Coast, a detailed survey of which is now being undertaken.

An important point emerging from this survey was the discovery that a region extending from the 15 to the 55-fathom line opposite Calicut abounded during November and December with the young of many varieties of food fishes. The area constituted a vast nursery at this time of the year. Another discovery was that S. W. and N. W. of Calicut between 21 and 29 fathoms the sea bottom is subject to great change, apparently due to the depth of the mud and sand. Trawling in this area in November and December 1928 revealed the presence of a rocky bottom—while fishing in the same grounds in April 1929 showed the complete absence of rocks. It is suggested that the strong currents set up by the monsoon, sweep the sea bottom of mud and sand and leave the rocks exposed at the end of the monsoon. Changes of this nature must have a definite effect on the type of fish which inhabit the sea-bed at different seasons of the year. The investigations and explorations now being conducted by the Madras Fisheries Department are slowly building up a mosaic of knowledge which will pave the way to the greater development of the fisheries under its control.

The fish supply of Bombay City is at present much below its needs. The local fisheries are not able to supply the demand and our markets are largely dependent on imports from Karachi, Broach, Damaun and the Kathiawar Ports.

The local fishing population on the caste basis numbers about 10,000 out of which about 6,000 work in the trade or are actually employed on the boats. The local fleet roughly numbers 210 boats of varying capacities. The smallest are worked by two persons. They operate within a radius of 3 to 4 miles from the shore. The larger boats or 'Muchwas', manned by a crew of half a dozen, go further afield to places like Bassein and Palghar where there are probabilities of securing large catches. The local trade has suffered considerably during recent years from various causes. Firstly the profits of the Industry do not go to the fisherment but into the pockets of contractors and middlemen. Owing

to the spread of education it has been suggested that there is a tendency among children of fishermen to give up the work of their forefathers and to seek their livelihood in Government service or elsewhere. Again, the increased cost of living in Bombay is reflected in the higher wages demanded by fishermen and by people engaged in the transport of fish to the market, in the increased cost of nets and fishing gear and the consequent increase in the price of fish; factors which have caused many connected with the trade to migrate to ports where labour is cheaper and where, as an additional advantage, taxes such as are levied in Bombay have not to be paid.

There are 17 municipal markets and 17 private markets in Bombay most of which handle fish which is brought from bunders such as Back Bay, Chowpati, Colaba, Worli, Mazagaon and Dharavi. In addition, fish is imported from various ports along the coast by steamer and rail. Catches landed at the local bunders are carried on the heads of coolies in open baskets to the markets where they are exposed for sale in the stalls. Complaints have been received from the public regarding this method of transport in open baskets exposed to the attention of crows, but no action can be taken by the municipality to remedy the existing state of affairs as there is no provision in the Municipal Acts which would empower them to do so. Besides the fishermen point out that covered baskets would accelerate decomposition.

The introduction of refrigerating chambers for the cold storage of fish has enabled local merchants to import iced fish from coastal ports and to store it till it is wanted. Fish brought by steamers from coastal ports are packed in air-proof ice boxes or ordinary boxes and baskets. An insufficient supply of ice often leads to decomposition of fish so transported. The railways do not provide, at present, cold-storage trucks for the transport of fish.

Imported fish is brought to the markets for sale or storage. The Crawford market and the Erskine Road markets are the chief distributing centres from which the smaller markets in the city receive their supply. In addition to cold storage at Crawford market there are other refrigerating chambers started by private enterprise. Among these are the plants maintained by the City Ice Supply Co., the Bombay Ice Manufacturing Co. and Dhunjibhoy Pestonji's Ice Factory. The storage capacity in Crawford market is about 100 tons of fish, frozen solid, at a temperature running down to 10 degrees above zero. The fish merchants are now able to fill the cold stores with fish when it is plentiful and cheap and sell it retail when expensive and scarce. This, while it may benefit the fish merchants and vendors, is of doubtful value to the fishermen or the consumer but better organization and better facilities for cold storage have enabled the city's demand to be increasingly met from outside sources.

To summarize:—

- (1) The present fish supply of Bombay City is not equal to the demand.
- (2) The local trade cannot cope with the city's needs which are being increasingly met by imports from outside sources

made possible by the establishment of facilities for cold storage.

- (3) The local industry has been adversely affected in recent years by increase in operating charges, due to higher cost of living in Bombay, taxes which have not to be paid at other ports and other economic causes which have influenced people connected with the trade to migrate to ports where working costs are less high.
- (4) The possibility of increasing the local supply of fish has been demonstrated by the operations of the trawler *William Carrick*.
- (5) The loss sustained by this vessel was due to faults in the conception and carrying out of the scheme.
- (6) While a great disparity between working costs and the returns from the sales of fish obtained is evidenced in the operations of the *William Carrick*, the experience gained by its initial exploration of our coastal waters indicates that power-fishing, not necessarily steam-trawling, in local waters is commercially possible.

The factors which should ensure commercial success are—

- (1) The reduction of working cost by the use of a smaller vessel with less coal consumption or as alternatives a steam-drifter equipped with a trawl, Danish seine-nets and drift-nets or :—
- (2) Motor-propelled cutters with similar gear.
A larger number of working days at sea than was possible with the *William Carrick*. This would ensure for commercially controlled vessels a greater output.
- (3) A fleet of 3 or 4 vessels which would enable daily landings of fish and thus guarantee regular supplies.
- (4) Power-fishing to be successful under local conditions must be run in conjunction with a well-thought-out system of cold storage and an efficient distributing agency.
- (5) Successful marketing of trawl-caught fish depends largely on the controlling concern being in a position to guarantee regular supplies for sale direct to the consumer without the intervention of middle-men.

Government co-operation is indicated in the investigation and the supply of data essential to commercial success.

A department of fisheries under the control of a Marine Biologist with practical experience of local conditions might with advantage provide statistics and information relative to :—

- (a) The various species of marketable fishes obtainable on one coasts, the quantities in which they are obtained and the value realized.
- (b) The ports at which various species are abundant at different seasons of the year and information as regards times of fishing and weight and values of fish obtained.
- (c) The fishing grounds and the depth at which the more important economic fishes are taken at different ports at different seasons.

- (d) The life histories, habits and periodic migrations of our more important economic fishes.
 - (e) The various types of nets used by local fishermen, the destruction of fry in creeks, rivers and estuaries by the use of particular types of nets or traps.
 - (f) Any conditions which are adversely affecting the local industry in Bombay,
- and finally :—Suggest measures for the utilization and development of by-products of the industry.

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THE STUDY OF INDIAN BIRDS.

BY

HUGH WHISTLER, F.S.Z., M.B.O.U.

PART VII.

(Continued from page 735 of Vol. XXXIV)

THE REPRODUCTION OF BIRDS.

Preliminary Remarks.

This series of Articles started with an account of the origin of birds and then went on to discuss some of their most striking physical characteristics. Now I propose to treat of certain aspects of their biology, that is, the study of their lives.

One of the most dominant motives of life is reproduction. Throughout the whole gamut of Nature, we find that one of her chief pre-occupations, one of her chief incentives to action, is the handing on of the torch of life. The present is but a fleeting moment. The life of the individual is all too short, a speck in the universe of time. The present and the individual alone are nothing and without meaning. Their significance is only attained when invested with a past and a future, when they take their places in the unending chain of destiny. Hence, consciously and unconsciously, the individual life finds one of its chief activities in reproduction; growth and maturity lead up to the reproductive period. That great duty accomplished, life descends to the common grave.

In the study of birds, in particular, we find that the many-sided aspects of their reproduction evoke the greatest interest and produce the most striking facts.

The Dialectician has often delighted to debate on whether the hen or the egg came first. I propose to settle the question in a summary way and say that the first item in the reproductive cycle of birds is found under the heading of courtship, using the term somewhat widely to embrace a number of points which lead up to the production of the eggs from which emerge the young.

The first point to get clear in one's mind with regard to the reproduction of birds is that the season for breeding is, as a general rule, a very sharply defined fact. The casual observer often draws his knowledge of the subject from the poultry-run. He sees the owner of a stock of poultry drawing a supply of eggs which appears to go on more or less throughout the year with no regard to season or anything else; and when he reads in the newspaper that a hen or duck in an egg-laying test has won with the extraordinary total of over 300 eggs in a single year, he is justified

in drawing the conclusion that a bird may be always in laying condition. This is far from the case.

It may be laid down as a general rule that a bird whether male or female, is only in breeding condition for a short and very definite period in the year. There is no need here to discuss the subject in detail. Those of us who are accustomed to collect birds and skin them, have necessarily to ascertain their sex by dissection. In the process one soon learns that the reproductive organs in both sexes lie dormant throughout most of the year. At a certain period they develop and the bird breeds; after the eggs are laid, the organs again diminish and become so small that they are difficult to recognize. These facts remain true whatever the breeding habits and whenever the breeding season. In the poultry-run, domestication has interfered with the normal cycles. The wild duck or the Jungle Fowl has a defined breeding season, a normal waxing and waning of the organs like any other bird.

In many books one may read apparent contradictions of my statement above. The House-sparrow and the various doves are said to bring up a succession of broods, or a particular species is said to breed throughout the year. Here looseness of language and thought are at fault. In Peninsular India it is quite true that nests of many species are to be found throughout the year. The climate is not one of extremes in many areas; food-supply is abundant; there is no particular factor to make one month a better breeding season than another. Thus it comes about that the eggs of a common bird, as for instance the Common Babbler (*Argya caudata*), may be found in a particular area in *any* month in the year, whilst if the bird is sufficiently numerous, nests may be found in *every* month. Individual birds go through their reproductive cycle, some at one time, some at another. The same birds do not breed all the time. The number of broods reared by an individual, do not necessarily differ from the numbers she would rear if exigencies of climate and food-supply directed all the pairs to lay at one time as in more temperate lands. A particular hole in a stable roof may hold a succession of sparrow broods. It does not follow, however, that each brood belongs to the same parents. Competition is severe and suitable sites are often scarce. There is no doubt that the normal brood for most species is a single one; many species certainly bring up two broods, and a few three; but there can be little doubt that the number of broods attributed to a species is generally exaggerated, especially in India. Any one who has had to collect birds in the breeding season, will probably bear out my experience that it is very rare to shoot a bird building a nest and find that it bears the unmistakable 'incubation patch' which a recent brood would imply. A bird may build a nest and lay a clutch of eggs. Some fatality attends the eggs—and such fatalities are very numerous in a land of dust-storms, crows, lizards, snakes, squirrels and small herd-boys—and the bird immediately proceeds to the production of a second nest and clutch, and sometimes a third endeavour is necessary before a brood is reared. But such second or third attempt does not mean that the bird is 'double-brooded' or 'rears three broods' in the meaning of the text books.

It is akin to that strange phenomenon by which some species can be induced to lay double or treble the normal number of eggs if an egg is daily removed from the nest so that the clutch does not accumulate. The ovary has some selective power of bringing to maturity eggs that would not normally develop.

In my experience the organs of male birds develop for the breeding season in advance of those of the females. From this probably follows the fact that courtship is in most cases the work of the male and also follows the acquisition of a 'territory' by the male as explained below. But before dealing with those points it is necessary to consider the various forms of union into which birds enter. These follow different lines which recall the various usages of mankind.

The normal union is that of one male with one female. This is so general amongst the birds not only of India but of the world, that the point need not be laboured or illustrated, except as regards the duration of such unions. Some are certainly for life; others are certainly only for a single breeding season. But the facts are not easy to study: and we have little definite knowledge.

It is fairly safe to assume, for instance, that the Raven (*Corvus corax*), the Sarus Crane (*Grus antigone*), and the Laggar Falcon (*Falco jugger*) are species which pair for life. A pair of Sarus Cranes will take up their abode in a particular jheel and there one will find them for the whole year. They rest and for a time they are accompanied by the young. Then the young vanish and the original pair remain in the place where one has always seen them. So marked is the devotion of the pair, one to the other, and so definite their attachment to one particular area that we are justified in considering it amounts virtually to proof that the union is one for life. The oft-repeated legend in India that if one of a pair of Sarus Cranes be shot, the survivor will die of a broken heart shows how definitely and generally it is believed, as the result of unconscious observation, that the birds pair for life.

So with the Raven and the Laggar. They are not birds which catch the notice of every one like the Sarus. But any observant naturalist soon learns certain salient facts in their life history. The nesting place is used year after year; the pair of birds are seen about together the whole year round; the same pair appear to have the same area of territory in which they hunt and live, and as acquaintance with them grows, a particular pair is found to have some little trick or habit which helps to establish their identity.

With the Raven there is another item of circumstantial proof. Wherever it is sufficiently numerous it has the habit of roosting in congregations. Early in my service in India I was posted to the Jhelum district, then particularly noted for the number of murders committed in the Chakwal Tehsil. As Assistant, I was usually deputed to hasten out to the scenes of successive murders and this involved a drive of about 40 miles by tonga from Mandra to Chakwal as the railway had not then been built. About halfway along the road there were some wayside trees which a large number of Ravens had chosen as their roosting place. When my journey took place by moonlight I used to see the Ravens, to the

number of 20 or 30 or more, sitting asleep up in the trees. When I travelled earlier in the evening I saw the birds flying over the country to the roosting place, and invariably they were in pairs. There were never parties as in the roosting flight of the House-Crow (*Corvus splendens*): there were never single birds. Always I saw pair after pair flying fast over the plain, to join the common roost. One can hardly avoid the conclusion from this that the pair which nested together, lived together throughout the rest of the year.

How far this is the case with smaller commoner birds is difficult to tell. We know that a covey of partridges or a party of tits of genus *Aegithalus* (such as the common Red-headed Tit of the Himalayas), consists in its origin of the pair of old birds with their young. We know that these family parties, if undisturbed, persist together until the spring; and we may suspect that when the breeding season comes again and the parties break up to breed the old original pair probably remain together. We notice a tendency also for many resident birds to be found about commonly in twos, generally of opposite sexes, which suggest that the pair remain together throughout the season. But our definite knowledge on the point is very meagre. It is on points like this that we shall ultimately hope to learn much from the activities of bird-ringers.

On the other hand there is no doubt that great numbers of birds pair afresh each season. It could hardly be otherwise with most of the migratory species. Though the fact that migration is not necessarily a bar to birds pairing for life will probably be admitted by all who have a full acquaintance with the Brahminy Duck (*Casarca ferruginea*). The marked way in which these birds remain in pairs during the winter on our Indian rivers, and the close relation that subsists between the pairs even when a number occasionally collect together, renders the conclusion irresistible that these migratory birds pair for life. In most migratory species, however, the chances are evidently against the same male and female finding each other, season after season.

Monogamy and polyandry are not common amongst birds, though of considerable interest in the cases where they occur. It is difficult to define their extent.

Some years ago it was generally believed that the majority of the larger game birds (*Gallinæ*) were polygamous. Now opinion has swung the other way, and turning over the pages of the new *Fauna*, one finds it asserted under most of the species that they are monogamous. I do not find that either opinion, so far as our Indian species are concerned, has been based on very definite facts or observation. The testimony of natives and the proportions between the sexes appear to be the only facts on which the theory of general polygamy was originally based; and it was confirmed to those who believed in it by the readiness with which birds in captivity fell in with arrangements based on the theory. The point is one which may be commended to observers in the field, but it will not be settled without difficulty.

Polyandry is the name given to the system of one female mating with several males. In India we are familiar with it in the case

of the Painted Snipe (*Rostratula benghalensis*) and the little Button-Quails of the genus *Turnix*.

Now there are some very interesting points connected with this reversal of the role of the sexes.

In both the Painted Snipe and the Button-Quails, the female bird is very definitely the larger and the plumage of the sexes is different. To human eyes at any rate the plumage of the female Painted Snipe is more beautiful and conspicuous, the male having to some extent the duller plumage which is commonly associated with the duties of incubation. The Painted Snipe is necessarily a difficult bird to study in its natural habitat, but fortunately the Button-quails are easy birds to keep in captivity; and what we know of their habits in the wild state has been supplemented and confirmed by aviculturalists.

The following facts are believed to be well authenticated. The females have a loud booming call, generally described as a *purr*, or a cross between a *purr* and a *coo*. This call is used for the same purposes as the call of the males of the game birds, that is to say as a challenge to others of the same and an invitation to those of the opposite sex. By the call the males are attracted to the females and other females also come and desperate contests ensue between them. Their pugnacity is so well known that it is utilized by native bird-catchers, who according to Jerdon in the Carnatic used to catch 15 to 20 females with a single female call-bird as decoy.

Once paired, the female is accustomed to feed the male with tit-bits from her bill, just as the males of gallinaceous birds are accustomed to feed their mates.

As soon as the eggs are laid the male begins to sit on them and broods them throughout incubation. When the chicks are hatched he feeds them and carefully brings them up, without any assistance from the hen who in the meantime has usually called and fought for and paired with another male. This male in his turn is furnished with a clutch of eggs to incubate, while it is believed that this succession of mates is often a fairly long one. The female herself never incubates and probably pays no heed to the young.

Promiscuity is not as a rule an avian habit. It is not certain whether it occurs at all normally amongst Indian birds, but I believe that the cuckoos of the genus *Cuculus* are promiscuous in their mating, males and females pairing for the moment and not uniting in a union of any duration. Something approaching this is said to occur with the Likh Florican (*Sypheotides indica*). It is believed that these birds do not pair but that the males have each a particular territory and that the females wander about until they succumb to the fascinations of a male and then they lay and incubate their eggs and rear the young without his help.

Very little is as yet known about the question of Territory, in the sense of a particular area in which a single bird or a pair of birds claim domination, so far as others of their own species are concerned. The sense of Territory is far from general. In many species it certainly does not exist at all. In a few it is

strongly marked; in the majority it is probably not very strong, and in almost all cases it is confined to the breeding season.

Now the pugnacious habits of the common Black Drongo or King-Crow (*Dicrurus macrocercus*) are known to every one in India. A pair build their nest in a tree and until the young are fledged and independent, the neighbourhood of that tree is the scene of incessant commotion. The King-Crows attack every passing bird of any size—Eagle, Kite, Crow and often far less dangerous birds—suspecting them of evil designs upon their nest, and other gentler species such as the Doves and Bulbuls often nest in the same tree and doubtless benefit from their protection. Though the King-Crows evidently define limits within which dangerous strangers are not tolerated, this is not a Territory in the specialized sense. The King-Crows are merely protecting their eggs or young from danger and they are not intolerant of others of the same species; in fact other pairs often come and fraternise with them.

A Territory *sensu vera* is maintained with reference to others of the same species. It is most easily understood by an illustration from a Himalayan stream. Camp alongside a Himalayan stream in summer and observe the White-capped Redstarts (*Chaimarrhornis leucocephala*) and the Plumbeous Redstarts (*Rhyacornis fuliginosa*) which are certain to be nesting along it. At regular intervals along the stream you will find pairs of each species. If you watch there you will soon discover two facts. Firstly, the pairs of each species parcel the stream out amongst themselves, so that the stream is divided into sections by the White-capped Redstarts and again into sections by the Plumbeous Redstarts. The sections often coincide for the two species so that each part of the stream lies within a section belonging to each species. Secondly, you will find that in any section the Plumbeous Redstarts and the White-capped Redstarts are not intolerant of each other. Occasional bickerings there will be between White-caps and their smaller relatives, but no more than is usual amongst neighbours. But each pair is very definitely intolerant of the presence of a stranger of their own species. If a Plumbeous Redstart from another section arrives within the territory of the local pair, it is immediately assailed and driven away again, and so with the Whitecapped Redstarts.

Here we have definite *Territories*, easy to see and understand because of their linear dimensions along the stream. In the fields and jungles similar territories exist but they are difficult for human perceptions to grasp without a great deal of careful observation.

It is easy to understand how the territory is started and maintained by resident birds which pair for life. I know a precipice in the Simla Hills where year after year the Shahin Falcon (*Falco peregrinator*) breeds. There are three nesting sites in that precipice used in turn in different years. The birds live there all the year round. They hunt in the neighbourhood, rest after hunting on the face of the precipice and sleep there by night. When they are nesting, woe betide the crow or eagle that ventures to fly across the face of the cliff. With shrill screams the Falcons pursue and buffet the bird till it is far enough away to please them, and so too would they doubtless treat any stranger of their own

species. Under such circumstances it would be strange if the Falcons did not come to regard this cliff and its neighbourhood as their own special territory.¹

With birds that pair for a single season, the importance of the territory varies. For many it certainly does not exist at all. For others its inception is probably delayed until after the nest is actually started, and its origin is merely sexual jealousy.

In many cases however it is believed that the possession of a territory by the male is a necessary antecedent to the obtaining of a mate. This subject has been carefully studied by Howard with reference to the British Warblers, and he came to the conclusion that with the little warblers of the genus *Phylloscopus* (so widely represented as breeding birds in the Himalayas) this was what happened. In the spring migration, the males were the first to arrive. They poured over the country side and as they came, each male in turn took up his abode in a particular group of trees until the locality was filled with the number of males for which there were suitable territories. The remainder passed on to other areas still untenanted—wave passing over wave. Then as the females arrived, they paired with those males already in the possession of territories. Unsettled males are not in a position to mate for they have no territory within which to choose a nest site.

How far this is correct it is difficult to say, but something like it undoubtedly occurs. I have noticed, for instance, how the Pied Bush-chats (*Saxicola caprata*) arrive in spring in the Punjab where they are mostly summer migrants. For a few days there are evidently only males about. They are conspicuous everywhere and a little observation suggests that individuals are stationary, each with its particular area where it will invariably be found. Then the females arrive and nest building begins at once. And so with the Purple Sunbird (*Cinnyris asiatica*) and other species.

Other birds certainly pair before they arrive in their breeding quarters. The Lesser Sand-Plover (*Charadrius mongolus atrifrons*) for instance indulges in all the displays and antics of courtship on the sands of Karachi before it leaves on its long non-stop flight to the breeding grounds in Ladakh and Tibet. Here the birds presumably arrive already paired and mutually select their nesting site.

Here a question immediately suggests itself. Do birds, other than those which pair for life, remember their nesting site from year to year and use it season after season? The question is very difficult to answer, but it is another of those that we may hope in time to answer through the ringing of birds.

It is evident of course that season after season the nests of certain species may be found in the same place.² A particular hole, for

¹ Such a territory once started, is maintained for generations. See '*Ootheca Wolleyana*', p. 98 in which Peregrine Falcons were discovered as occupying the same eyrie in 1736, 1799 and 1853.

² See, for instance, the famous case quoted by Yarrell (*British Birds*) of Blue Tits nesting in an earthenware bottle from 1779 (or 1785) to 1873 with the exception (for special causes) of only 2 years.

instance, will contain the nest of a Tit or a Magpie Robin for several years in succession. Under a particular culvert there is always the nest of a Wire-tailed Swallow (*Hirundo smithii*). A pair of Little Ring Plovers (*Charadrius dubius jerdoni*) always seem to nest on the same shingle bed. But there is usually nothing to show that the birds which nest there one year, are those that bred there the year before. It may be that really desirable sites are scarce and that a site is selected by one pair for the same reasons that influenced its predecessors, or possibly one or both of the birds survive from previous years, remember the site and return to it.

The probability would seem to be that all birds desire to nest where they nested before, or where they were themselves brought up; but innumerable chances lie in the way of fulfilment of this desire. Where birds are strictly resident, there should be fewer obstacles in the way, the destruction of the nesting site, its appropriation by a stronger individual or species, and the heavy chance of casualties during the year. But in the case of migrants, the odds are far heavier: for one bird that returns after an absence of months and a journey of thousands of miles to the exact spot of its desires there must be numbers which have fain to be satisfied with a safe return to the general area. That some birds do actually return successfully to the particular nest site has been proved by ringing. That all desire to, is suggested by the following circumstantial evidence:—

It is a commonplace now of knowledge how hard it is to induce migratory birds to return as breeding species to an area from which they have been exterminated. The Ruff and Reeve (*Philomachus pugnax*) and the Black-tailed Godwit (*Limosa limosa*) for instance were once extremely common breeding species in the eastern counties of England. They were exterminated as breeding birds in the course of the last century by heavy destruction of the birds and eggs in the breeding season. Suitable marshes for them still exist where ample protection would be afforded to them; and every spring quite a number of both species pass through on migration, while colonies of both birds are still numerous in Holland but a short flight away. Yet there is no more than an occasional isolated attempt by any of these migrants to breed in their old haunts. The explanation apparently is that all the migrants are tied by unconscious memory—the homing-instinct—to breed where they were bred or had bred before. The local strain whose ties were with the English marshes is dead; and no fresh strain will start there so long as the migrants find their own ancestral marshes available. If by some means a number of pairs could be induced to breed one summer in the English marshes, their descendants would return there year after year and the species be reinstated as a British breeding bird.

Courtship

With these preliminary observations we may turn to an examination of the courtship of birds in the stricter sense of the words. It needs only a slight acquaintance with birds in the field to make

one realize that the period immediately antecedent to the building of the nest and the laying of the eggs is one of great activity, more especially on the part of the male. This activity expresses itself in various ways, but in the main these ways fall under two heads. Either the bird expresses its excitement by movement, or by noise—the two most primitive methods in the world of nature.

Within the possibilities afforded by these two methods we find an infinite variety of expression and it is customary to divide them under two headings, display to attract the mate and force to drive off the possible rival; while together they are held to account for the sexual dimorphism of most birds, acting through natural selection.

Display has a wide range. Pycraft cites the case of the House-Sparrow thus:—‘The grotesque manner in which he struts with drooping wings and outspread tail around his mate’; and rightly points out that it is nothing more or less than the same type of display which we see in birds like the Pheasants and the Peafowl where the grotesqueness of the performance (in human eyes) are lost sight of in the splendour of the plumage and its special developments that the performance reveals. Between the strutting and posturing of the sparrow and the display of the Peacock (‘in his pride’ as the old Heralds aptly emblazoned it) there is no difference save of degree. There is no need to labour examples of the display pure and simple; each can readily furnish them from his own experience.

It may, however, be of interest to mention one or two examples where for the purposes of display, feather ornament has been reinforced by body structure or behaviour.

A familiar example of the latter is furnished by the Common Lora (*Ægithina tiphia*). In the breeding season the male flies up into the air and then spirals down to its perch again, with all the feathers spread out, especially the long loose plumage of the rump, until it looks almost like a ball; while descending it utters a strange protracted sibilant sound, recalling the note of a frog or cricket. Arrived on the perch it spreads and flirts the tail like a little Peacock, drooping its wings and still uttering the curious note.

Reinforcement of plumage displays by bodily structure is most familiar in the use of air sacs. The stock example is that of the pigeons of the Rock-Dove (*Columba livia*) group with their domestic derivatives. As the male turns and twists and *coos* before his mate, beak pointing to the ground, he inflates his neck both for the purposes of the noise and to exhibit more completely the lustrous colours on the neck. Here the inflation is apparently merely of the crop and gullet with no special structures in addition.

In the Bustards a special pouch or gular sack, opening under the tongue, has been developed to carry this type of display still further. I do not find that this pouch has been definitely dissected and described for our Indian species¹ *Choriotes nigriceps* (= *Eupodotis*

¹ Can no sportsman who shoots a male bird preserve the head and neck in spirit for the purpose?

edwardsi) though its structure is well known in the European Great Bustard (*Otis tarda*). That it exists is evident from Hume's account:—

'The way in which the male expands the throat at times during the breeding season is most extraordinary. . . . First the male begins to strut about, holding his head up as high as if he wanted to lift himself off his legs; then after a few turns, he puffs out the upper part of the throat just under the jaws, then draws it in again, then puffs it out again, and so on, two, three or four times, and then suddenly, out goes the whole throat down to the breast, and that part of it next the latter swells more and more; his tail, already cocked, begins to turn right back, over the back, and the lower throat bag gets bigger and bigger, and longer and longer, till it looks to be within six inches of the ground. All the feathers of the throat stand out, and looked at in front, he seems to have a huge bag covered with feathers hanging down between his legs, which wobbles about as he struts here and there with wings partly unclosed, and occasional sharp snappings of his bill. From time to time he utters a sort of deep moan, and stands quite still.'

The Adjutant Stork (*Leptoptilos dubius*) is provided with a somewhat similar pouch. When deflated it is hardly visible and appears merely as a conical swelling of bare skin in front of the neck. It differs from that of the Bustard in the speed with which it can be inflated and deflated. It suddenly shoots downward as a large naked windbag of considerable size and as suddenly disappears. It is filled from air sacs opening into the nose but the display in which it is used does not appear to have been described and an opportunity of placing most valuable information on record here lies open to the hand of some member of the society.

How far the presence of these remarkable air pouches in the Bustard and the Adjutant is seasonal appears to be unknown, but in the Frigate-birds (*Fregata*) the large scarlet pouch beneath the throat which can be inflated until it equals the body of the bird in size is evidently acquired in connection with the breeding season.

A variant of this type of reinforcement of plumage by structure is found in the fleshy horns and bibs of the Tragopan Pheasants (*Tragopan*), which are expanded during the display.

It is not strange that pugnacity amongst the males should be a feature of the courtship period of birds; and such pugnacity often merges with display. General displays at preconcerted meeting places for numbers of birds of both sexes are well known amongst birds. Though such may easily occur amongst our Indian birds I do not recall to mind that any have been actually observed and recorded. Although it is a well-known migrant to India we are not privileged to see the Ruff (*Philomachus pugnax*) either in his tournaments or in his tourney-attire. As we see it in India the Ruff and his consort the Reeve are plain looking brown waders with nothing but size to distinguish the sexes. After they leave India in the spring the male assumes a wonderful breeding dress. The feathers of the face are shed and their place is taken by small fleshy papillæ of bright yellow or pale pink. From each side of the head sprouts a tuft of stiff curled feathers giving the appearance of long ears, whilst below the throat appears a most remarkable

frill or ruff of stiff curled feathers over two inches long. The ear-tufts and ruff are very variable in colour ranging from black or white to chestnut, spangled, speckled and barred, and often glossed with violet, blue or green. The ear-tufts and the ruff are very dense and stiff in texture and they are capable of depression and elevation so as to form a shield to the bird.

During courtship the Ruffs select as tiltyards certain eminences in the marshes where they breed. There at day-break the males assemble and regular tournaments go on. To quote from a writer on the subject:—‘The performers assemble at the favoured spot and commence at once to disport themselves, now sparring one with another, and now standing one in front of another with outspread frill and head bent down till the beak rests upon the ground, immovable, only to commence again to spar. Now and again some display of temper is shown, one bird endeavouring to seize another by the beak and administer a rain of blows with its wings; or the two will rise in the air and strike at each other with their feet. The more vigorous appear to take possession of certain definite areas and to hold these against all comers. Sooner or later the females appear on the scene, when they are courted vigorously by the males, who display their frills assiduously.’

The Black Game (*Lyrurus*) of Europe is another species celebrated for these concerted displays and it may be that some of our lesser known Indian birds indulge in them.

Individual pugnacity is of course a common incident of courtship.

The disreputable scimmages on the ground in which the House-Sparrows (*Passer domesticus*), the Mynahs (*Acridotheres tristis*) or the Babblers of the genera *Argya* and *Turdoides* grapple and struggle with wings and beaks and legs afford the most obvious examples. Such pugnacity is more developed in some species than in others. The ordinary small passerine bird is not as a rule a very determined fighter. In fact I have always noticed that dash and initiative always counts for more than actual pecks or blows. If one small bird flies at another, the latter almost always gives way without resistance; a mere dash by a small bird is sufficient to put a large one to flight without their relative strengths being really tested.

Definite fighting is far more developed amongst non-passerine birds; and in the group where it reaches its apex, the *Gallinæ* it is accompanied by the development of offensive weapons in the form of spurs. The deadly weapon that a tarsial spur is capable of becoming is known to all who have shot the males of the various Jungle-Fowls (*Gallus*) and the extreme pugnacity of this group is evident from the intolerance of the chicken-run. Unless and until one cock is master definitely of the poultry yard, there are incessant conflicts ending perhaps in the death of a combatant.

The tarsial spurs are in all Indian Game birds in pairs, one on each leg, except in the case of the Spur-fowls (*Galloperdix*) where the number is irregular and variable, as many as three spurs occurring on a single leg. It does not appear, however, that the extra number of spurs has any connection with a more pronounced pugnacity and one can only conclude that Nature's infinite tendency to variation has in this case become a generic characteristic.

That the presence or absence of spurs is not correlated with the degree of pugnacity is evident from their absence in the true quails (*Coturnix*), so esteemed in India as captive fighting birds. Spurs are not confined to the legs. The Spur-winged Plover (*Hoplopterus ventralis*) of the great rivers of the Indo-Gangetic plain and the Pheasant-tailed Jaçana (*Hydrophasianus chirurgus*) are well known as possessing a similar spur on the carpal joint of each wing. We are commonly informed that both these species use the spur for fighting at the breeding season, but I personally have never seen either species make use of it and doubt the correctness of the usual statement.

It should be remembered in this connection that the Bronze-winged Jaçana (*Melopidius*) has the radius of the wing broadened out from its middle onwards, in the form of a flat plate, and this is considered by Pycraft to be also intended as a weapon, though this also seems doubtful.

Akin to the ceremonial side of the tournaments held by some birds must be considered the habit of dancing. Virtually nothing has been recorded about this habit amongst Indian birds though it must be practised by some species. That delightful species, the Demoiselle Crane (*Anthropoides virgo*) owes its name not only to its graceful figure but also to its habit of indulging in set dances though these of course take place in its breeding quarters and not in India.

W. H. Hudson in his fascinating writings has recorded elaborate dances by the Cayenne Lapwing, Ypecaka Rail and the Jaçana of South America, but there is no reason why we should not discover that allied birds in India indulge in similar ceremonial. But unfortunately Naturalists in India have devoted much time to collecting specimens and paid little heed to the observations which would reveal so much of interest in the life-histories of the birds they collect.

Akin to the dance is the elaborate ritual of courtship recorded at some length in England for the Great Crested Grebe (*Podiceps cristatus*), another species that we know best as a winter visitor in India. This ritual is said to culminate in a pose when male and female rise high out of the water, breast to breast, each holding a piece of water-weed in their bills.

As stated earlier, noise in some form or other is a very important accompaniment to the courtship of birds. It may profitably be considered under two divisions, vocal and instrumental. To deal with vocal music first :—

It is well-known that a very large proportion of birds signalize the approach of the breeding season by breaking into song. I here use the word song in a liberal sense to include not only those bird-songs which are really worthy of the name but also those monotonous chirpings as of the House-Sparrow (*Passer domesticus*) or loud calls as in the various Cuckoos (*Cuculidæ*) which at the breeding season undoubtedly occupy the place of a true song. To the Koel (*Eudynamis scolopaceus*) and the Brain-fever Bird (*Hierococcyx varius*) the loud incessant calls which drive some human beings to despair fulfil the same function as the wondrous song of the Nightingale. Both are an expression of the sexual excitement of the season ; both are a

stimulation to that excitement; and both are a message to the opposite sex. It is easy to see how song developed from the call note. We see the first stages of the development in the shrill and incessant noise of the breeding cock-sparrow who possesses merely his single harsh note as a call but works it with passion into the substitute for a song.

It may not be out of place here to explain that a bird's voice is not produced in the same way as that of other animals. In mammals the vocal chords are in the larynx, at the top of the windpipe; in birds they are situated in a special song-box, the *syrinx*, at the foot of the windpipe where it branches into the two bronchial tubes leading to the lungs. Birds actually possess a larynx, like mammals but in their case it has no connection with the production of the voice.

Anatomically considered, the syrinx is rather an intricate organ and there are many variations in its constituent or accessory parts. In the Cranes (*Grus*) for instance the windpipe (*trachea*) is greatly elongated and the space for the extra length is found in a long chamber formed by the keel of the breast-bone. In the Spoonbill (*Platalea leucorodia*) a figure-of-eight convolution provides for the extra length of windpipe. In many of the ducks there is a special hard resonating sac or 'Sound-box' attached to the side of the trachea. These modifications are by no means properly understood. It does not appear possible to establish any exact correlation between the intricacy of the song and the complexity of the instrument but the more complicated variations in birds are often only found in the male of a species.

It is interesting to remember that in the female of the Painted Snipe (*Rostratula benghalensis*), where as we have seen above the role of the sexes is reversed, there is said to be a convolution of the trachea confined to that sex (though I confess I have so far failed to find it in either sex when I have dissected them).

I have said above that song is an expression, a stimulation and a message of sex-impulses; and that this is true, is clear from the direct connection between song and the hormones contributed to the blood by the reproductive organs. These hormones prompt or inhibit sexual characteristics. The 'breaking' of the voice in young men, the crowing of hens whose ovaries are atrophied or in whom there is development of testicular matter are examples of the connection. But at the same time the fact must not be lost sight of that song is also based on something else than sex. The Wren (*Troglodytes*) or the Dipper (*Cinclus*) that sings amidst the Himalayan snows in the depth of winter is clearly at the moment free from the impulse of sex. There is some metabolism of super-abundant energy and excess of well-being that relieves itself in song and it may be that there are vestiges of an æsthetic sense which sings for pure delight in the beauty and the sound of the song. It certainly seems like it.

Whatever the full gamut of feelings to which vocal music amongst the birds is due, it is supplemented by instrumental music. The simplest form of percussion music, says Pycraft, is perhaps that produced by the White Stork (*Ciconia alba*). Throwing the head

backwards till the point of the beak almost touches the back, the jaws are set rapidly in motion, clashing one against another and producing a curious rattling sound, which has been compared to castanets. As the sound is being produced the head is slowly turned into its normal position ; but not until the beak has described a half-circle and rests almost on the ground does the music cease. I believe that similar performances are indulged in by other Indian storks but unfortunately there is little on record about them.

More curious is the deliberate drumming by Woodpeckers. It is a favourite habit of many species—In India I have noted it in the cases of *Dryobates sindianus* and *Leiopicus mahrattensis*—to select a rotten branch of a tree as a drum. This they repair to at intervals, I believe only in the early breeding season, and drum on it with their beaks, using the method and producing the effect of the 'rolling' of a kettle-drum. The result is most striking and it is evident that the action takes precisely the place of the song of other birds. It is evident that the Woodpecker is precisely aware of what it is about.

Whether this is so in the case of a Drumming Snipe (*Capella caelestis*) is harder to understand. The drumming of the Snipe is one of the most famous curiosities of natural history. Unfortunately it is confined to the breeding season ; so we in India are never privileged to hear it. My first experience of it took place after my retirement from service.

On these occasions a Snipe mounts high up into the air above the marsh where it is breeding. There it wildly circles about and flies a random zigzag course until it suddenly shoots downwards and aslant and then as abruptly mounts again to its former elevation and this process it repeats again and again. During each descent a sound is heard, variously described as drumming or bleating, but which to my ears is best described as being like the sound of the hoofs of a galloping horse. There seems no doubt that this sound is produced by the passage of the air through the two outer tail feathers which acute observers may see held out separately well in advance of the fan-spread tail. An equivalent noise is made by some of the various other snipes and the possession of this faculty is evidently correlated with the curious variations in the outer tail feathers of the members of this genus.

In writing this chapter it has once more been brought home to me how little we know of our Indian birds. Europe has in the past been lucky in its observers who have set themselves to study and record the extreme interest of the habits of all the more distinctive birds. The result is a mass of material from which other writers have been able to select, and build up various studies and theories of biological significance. The birds of India provide an assembly of interesting and curious forms, the significance of which we are still unable to estimate. For in India the naturalist has been little more than a collector, a fault largely engendered by the fatal ease with which shikaris can be engaged to bring in and preserve a quantity of eggs and birds with little or no trouble to the collector who often contributes little but the labels. I fear that the richness of the Indian avifauna will soon be a thing of the past ; but while it still remains in some abundance, there is still time to observe and

record the ways and habits of our birds. If this is done, explanations will be found for the amazing diversity of form and structure which at present are known to us merely as isolated facts.

Biologists have long felt the need of accounting for sexual-dimorphism, that is the fact that amongst birds (and in other groups too) the male is so often larger or more vigorous than the female, and that his plumage is so often more striking and conspicuous. The assumption of special breeding plumages, more especially by male birds, is also remarkable. Darwin thought that the courtship of birds had given him the clue to the explanation. He studied the tournaments of the Ruffs and Black Cocks, the plumage displays of the Peacock and the Bird-of-Paradise, the song of the Nightingale and the other manifold forms of courtship which we have endeavoured to outline above. He thought that behind it all he could find a proof that the more vigorous male—whether vigour were expressed in terms of strength in the duel or beauty in the display and concert—had the first choice of the females, whilst the least vigorous males were left unmated. At the same time he thought there was evidence of preferences shown by the females, that success in the contest of males was accompanied by positive choice by the females. Combining these two factors he arrived at the theory that sexual dimorphism was the result of evolution working through this sexual selection.

There are difficulties in the way of accepting the theory. But although later writers have evolved other theories to account for the facts, one and all have difficulties in the way of their acceptance. In the meantime, there is work for all to do in observing and recording the phenomena of courtship in the hope that a fuller knowledge of the facts will lead to a correct understanding of the guiding principles behind.

THE BUTTERFLIES OF COORG.

BY

J. A. YATES.

PART II

(Continued from page 1014 of Vol. XXXIV.)

VIII.—Family. LYCÆNIDÆ.

H 5. 4. *Gerydus biggsii*, Dist. On March 16, 1929, while I was catching on the Paiyaswani River, Sampaje ghat, one of my servants took an obvious *Gerydus*, identified for me by Evans as *Gerydus biggsii* ♀: another of my party told me that he too had caught a very damaged specimen, but, not realizing its rarity and novelty, had thrown it away. It was caught on a low branch of a tree on an island in the middle of the river.

H 9. α. *Spalgis epius epius*, Wd. This insect, common round Bangalore in the dry jungles where it haunts bushes and small trees, does not seem common in Coorg, at least in the months I have spent in the province.

H 11. *Neopithecops zalmora*, But. Common throughout the province in the intermediate and evergreen areas. Has a lazy flight; is a low flier round and among trees and bushes. Comes to water.

H 12. α. *Megisba malaya thwaitesi*, M. Have only seen it in any numbers in the evergreen country; and chiefly on damp patches on the roads and on damp sand among stones and rocks by the rivers, notably on the ghats and below the ghats.

H 13. α. *Talicauda nyseus nyseus*, Guer. Well distributed, and at certain spots abundant. Flies late in the evening sun, until very nearly dark. Have noticed it then settle gregariously along low twigs with closed wings, often on the underside.

H 14. 1 α. *Castalius rosimon rosimon*, F.

H 14. 2 β. *Castalius caleta decidia*, Hew.

H 14. 3 α. *Castalius ethion ethion*, Db. and Hew.

All three common in Coorg; on the whole, at any rate in the intermediate and evergreen country, the last two commoner than *rosimon*, which is the usual *Castalius* in the dry country round Bangalore, where *caleta* is rare, and *ethion* (so far as I know) does not occur.

All three are low fliers, *C. rosimon* seems to fly much more in the open sun, round bushes, and over grass and low flowering plants. *Caleta* and *ethion* are distinctly woodland butterflies.

H 15. 1. *Tarucus ananda*, De. N. This beautiful little fly, so far as my experience goes, is much more usual in Coorg than the next. It flies rather high (10' to 15') round certain trees, but comes down freely to damp patches. It is found both in the dry forest (e. g., in October) and in the evergreen country, above and below the ghats.

H 15. 2. *Tarucus theophrastus nara*, Koll. I have only seen this at Napoklu in open grass land in March. It is uncommon also round Bangalore, where I have only seen it after the monsoon breaks in June and July. A lower flier than the last.

- H 16. 1. *Euchrysops cnejus*, F.
 H 16. 2 β . *Euchrysops contracta contracta*, But.
 H 16. 3 β . *Euchrysops pandava pandava*, Hors.

All three in Coorg ; *E. contracta* the least common there and round Bangalore. All low fliers in the open, round low plants, bushes and flowers. Settle on damp ground.

H 17. 3 α . *Everes parrhasius parrhasius*, F. Throughout Coorg but never abundant ; at all elevations from near the summit to the foot of the hills. A low flier in the open ; settles on damp ground.

H 20. 5. *Lycænopsis akasa mavisa*, Fruh. Fairly common especially in the evergreen areas and particularly on the ghats. Flies along banks and round trees and bushes, at from 3 to 10 feet or so ; settles on flowers. Occasionally at water.

H 20. 15 β . *L. puspa gisca*, Fruh. Common everywhere. Comes freely to damp earth.

H 20. 16. *L. illacea*, Hamp. This beautiful butterfly is well distributed in Coorg. $\sigma\sigma$ are gregarious in their habits at water on damp roads, etc. $\omega\omega$ are rare, and taken singly near or in jungle. Appears to be annual, though more abundant September–October and March–May.

[I have not taken *L. albidisca* and *L. limbata* in Coorg.]

H 21. α . *Chilades laius laius*, Cr. Common in Coorg, both W.S.F. and D.S.F., as elsewhere. A low flier.

H 22. 1 α . *Zizera trochilus putli*, Koll.

H 22. 2 α . *Z. maha ossa*, Swin.

H 22. 3. *Z. lysimon*, Hub.

H 22. 4. *Z. galka*, Trimen.

H 22. 5 α . *Z. otis decreta*, But. Throughout the province.

H 27. *Syntarucus plinius*, F. General and common.

H 28. 1. *Catachrysops strabo*, F. Do.

H 29. *Lampides boeticus*, L. Very common.

H 30. 2 β . *Nacaduba pactolus continentalis*, Fruh. I took four $\sigma\sigma$ in April 1929 on the Sampaje ghat : identified by Evans, as *continentalis*. I thought they were the first specimens caught in S. India, till recently I saw in Col. Winckworth's collection a ω taken at Urti in 1927. Those I took were all taken on one short stretch of road near mile 13 from Mercara. Though I spent many hours in looking for other specimens, I could see no more. *N. hermus nabo* was fairly common at that place just then, and *N. pactolus continentalis* settled with *hermus*.

H. 30. 3. *N. hermus nabo*, Fruh. By no means one of the commonest species in Coorg ? $\omega\omega$ are distinctly rare. $\sigma\sigma$ come down to damp earth.

H 30. 7 α . *N. viola viola*, M. I have found this attractive little insect in various places from the edge of the dry area to the foot of the ghats in the evergreen country. Sometimes it is almost abundant, e.g., in February 1929 on stones and sand by the Paiyaswani River (Sampaje ghat).

H 30. 8 β . *N. atrata euplea*, Fruh.

H 30. 9. *N. akaba gythion*, Fruh.

Both these are common throughout. Like other *Nacadubas* come freely to damp earth.

H 30. 14. *N. nora*, Fd. Abundant in most places.

H 30. 15 α . *N. dubiosa indica*, Evans. Common, but not abundant like the last.

H 30. 16β. *N. noreia hampsoni*, De N. Rare, if not very rare.

H 30. 17β. *N. dana*, De N. Where it occurs is common, almost gregarious on damp earth. Round Bangalore; I have found it common in places on the flowers of Maddi (*Terminalia tomentosa*).

H 31. 1α. *Jamides bochus bochus*, Cr. Common or at any rate widely distributed. More numerous in the rainy months (June and July) round Bangalore than anywhere in Coorg! not seen at water. Flies round bushes.

H 31. 6β. *J. celeno celeno*, Cr. Common, but in the evergreen area less common than the next.

H 31. 7β. *J. elpis curysaces*, Fruh. Widespread. More of a woodland species than the last.

All three *Jamides* occur throughout the year. *J. celeno* and *J. elpis* vary considerably in colouring and markings according to the season.

H 32. 1. [*Azanus ubaldus*, Cr.]

[*Azanus uranus*, But].

[*Azanus jesous gamra*, Led.]

I have recorded only the first in Coorg. I did not trouble to look for them in Coorg till too late for the purposes of this list. Obtained round Bangalore.

H 33. 1α. *Lycænesthes emolus emolus*, God. According to Evans common, but in Coorg at any rate, it is not. I have only found it on the ghats, in October, January, March, April and then only sparsely: in October on the flowers of a *cæsalpina* at other times chiefly on damp earth. It does not occur, so far as I know, round Bangalore.

H 33. 2α. *Lycænesthes lycænina lycænina*, Fd. 'Rare' [Evans]. It is however very common and universal in Coorg and in all the jungles round Bangalore, especially on sandal flowers. In Coorg it is plentiful near streams and on damp roads.

H 45. 1 and 2. *Curetis æsopus*, F. and *Curetis thetis*, Dry. Both are common in Coorg, as round Bangalore. I have seen a series drawn up in which the transition from the characteristics of *thetis* to those *æsopus* (♂♂) is so gradual that it is difficult to tell where one begins and the other ends, or a break occurs which would justify a differentiation into two species. There does not seem to be any means of distinguishing ♀ of one from ♀ of the other.

H 45. 6. *C. acuta dentata*, M. This species does not occur round Bangalore: it favours larger jungle and particularly the neighbourhood of streams and rivers. ♂♂ are abundant in many places, e.g. on the Paiyaswani river, on the Nagarhole (eastern forests). The ♀♀ are rare: at any rate hard to get; they do not come out into the open as do ♀♀ of *C. thetis*.

[H 46. 1β. *Iraota timoleon timoleon*, Stoll. May occur; on the eastern side are many trees of the kind of banyan it favours round Bangalore, but I have no record of it. Hannington does not mention it.]

H 47. 1β. *Horsfieldia anita anita*, Hew. Hannington remarks, 'is rare in the northern open country in June and November'. I have, however, found it in the northern and eastern forests in January, April, May and September and under the Brahmagiri range in October and again from January to May: nearly always fresh specimens were to be had. It would appear to be *annual*. Where it occurs it is fairly plentiful. It seems to favour wooded streams, and comes freely to water in sunny spots or at the debouchment of a stream into open country, in paddy-fields, on flat rocks, etc. In April and May at two spots in the northern and eastern country the specimens I took were underneath nearly black with a purplish tinge. I have not seen it on the ghats.

H 48. α. *Thaduka multicaudata kanara*, Evans. Hannington says: 'May be looked for on the western slopes below 2,000 feet in May, August and September, I have taken it at Irpu and Kakkotpole (3,000 feet) above the ghats. It is to be had on the ghats certainly in October, and every month from January to May. I have always taken it near streams or rivers, settled on bushes or trees, but not on the ground at water.'

H 50. 34. *Amblypodia canarica*, M. Distinctly rare. I have taken it at Napoklu and Srimangala settled on Neale (*Eugenia Jambolana*). Also on the Sampaje ghat on lantana and at Watercolli on another *Eugenia* (*C. Eugenia hemispherica*?). I have seen it settle on a wet stone near the Paiyaswani River.

H 50 37. *a. A. centaurus pirama*, M. Occurs both above and below the ghats, in intermediate and evergreen country. At Srimangala I found the *pupa* of a female rolled in a leaf of Nerale (*Eugenia jambolana*), almost ready to emerge.

H 50, 40 *a. A. amantes amantes* Hew. I have taken this abundantly round Bangalore on mango and nirale chiefly. Hannington records it in Coorg.

H 50. 46. *A. bazaloides*, Hew. I have only seen and taken this on the ghats on the evergreen forest on the lower parts of the Periambadi and Sampaje ghats. Settled on leaves, e.g. Lantana. It is distinctly rare; taken in October or February.

H 50. 72 β . *Amblypodia abseus indicus*, Riley. I took one specimen (\varnothing) on a wet stone in the shade by the Paiyaswani R. February 1929. It was kindly identified for me as *indicus*, Riley by Evans not *muckwoodi* as one might have imagined from the nearness to Ceylon. Apparently the first recorded from S. India.

H 51. 1 β . *Surendra quercetorum quercetorum*, But. In the evergreen country, chiefly on the ghats, flying on the edge of the forest by the roadside. In my experience this is not so common in Coorg as the next.

H 51. 4 *a. Surendra todara todara*, M. Hannington records it from Fraserpet or Pollibetta in August, e.g. from the dry and intermediate areas. It is more frequent in the evergreen country and occurs in other months, e.g., on the Periambadi and Sampaje ghats in September and October, and again in March and April; at Napoklu in February and March, and at Fraserpet in May not seen at water. On trees and about bushes.

H 54 β . *Loxura atymnus surya*, M. Well distributed throughout the intermediate and evergreen country. It occurs certainly from September to May on the edge of woods or in woods.

H 57. 3. *Apharitis lilacinus*, M. Evans gives Bangalore as a locality: I have not seen it there, but have taken it at several places in Coorg in evergreen forest; e.g. at Appugala, Irpu road, close to Nalknad Palace and on the Sampaje ghat. In each case it was very local, flying round one or two bushes or small trees, settling on the leaves, darting off and returning. Taken only in February and March.

H 58. 1 β . *Spindasis vulcanus vulcanus*, F.

H 58. 2 *a. Spindasis schistacea schistacea*, M.

Both common.

H 58. 3. *Spindasis abnormis*, M. Recorded by Hannington.

H 58. 5 β . *Spindasis ictis ictis*, Hew. Occasional but not common in Coorg, whereas in places round Bangalore it is fairly plentiful, especially in July-August.

H 58. 12. *Spindasis lohita lazularia*, M. This is perhaps the commonest *Spindasis* in Coorg; at any rate in the evergreen area. At times it is almost abundant, e.g., in W.S.F. on the Periambadi ghat after the monsoon in September-October. D.S.F. occurs from December to April, when W.S.F. begins to appear again. It particularly favours, as do other *Lycænids*, the flowers of *Clausera indica* (?). It occurs also in the intermediate and dry areas, e.g., at Fraserpet in May. Not seen on the ground, as *S. schistacea*.

H 59. *Zesius chrysomallus*, Hub. I have taken only one bad specimen, (\varnothing), in Coorg; it had no blue on the upper wings. I have however taken it freely round Bangalore in certain jungles, especially jungles where there are many yellow tree ant nests, in which it has its larval and pupal stages. There appear to be clearly distinct W.S.F. and D.S.F. The former appears in June and continues till about November. In W.S.F. the copper red of $\sigma\sigma$ is darker and has

a bluish tinge. In D.S.F. the red is paler without the blue tinge. In D.S.F. also the underside is less distinctly marked, the red of the spots in extreme D.S.F. (e.g., in April) almost disappearing. Similarly the blue of ♀♀ in W.S.F. is deeper and more metallic than the blue of D.S.F., which is slightly chalky with a tint of brown underneath. The underside D.S.F. also is paler than W.S.F. and the marks less pronounced than W.S.F.; the red of the spots tends almost to disappear.

H 61. 3 α. *Pratapa blanka sudica*, Evans. Distinctly rare: I have taken only ♂♂, (1 on the way to Marinad from Hudikeri, (2) on the Sampaje ghat. One was taken on a leaf by the way side; the rest were taken on the ground, having come down from a high branch of a tree.

H 61. 4 α. *Pratapa deva deva*, M. No record. It should be in Coorg.

H 61. 7. *Pratapa cleobis*, God. Certainly rare in Coorg, but apparently more widely distributed than *P. blanka sudica*: I have it from Madapur (N. Coorg), Bhagamandala (W. Coorg), and Urti (below the ghats). All were taken on bushes or low trees.

H 65. 15. *Tajuria jehana*, M. Only one record from Coorg. It may, however, be commoner in the dry forests. It occurs in many jungles round Bangalore on a small white-flowered acacia.

H 65. 16β. *Tajuria cippus cippus*, F. I have only taken it in the intermediate area. It is common in many jungles round Bangalore and occurs in most months of the year.

[The probable reason for my getting so few of either of these *Tajurias* in Coorg is that having got plenty round Bangalore I was not on the look out for them.]

H 65. 21α. *Tajuria jalindra macarita*, Fr. I think this must be very rare in Coorg; I looked for it for two years, but only got one specimen (♀) on wet sand by the Paiyaswani river in deep shade.

H 75β. *Cheritra freja jafra*, But. Fairly common in all evergreen wood, round bushes and trees and near the edge of jungle.

H 81. *Rathinda amor*, F. Not common in Coorg, where I have only seen stray specimens: this is the case at least in the intermediate and evergreen areas. Not as in some of the dry jungles round Bangalore at times, e.g., after the rains break, in June and July, almost gregarious and abundant on *Eugenia jambolana*, etc.

H 82. 1α. *Horaga anyx cingalensis*, M. Rare, have only found it in the evergreen country, e.g., at the top of the Perimbadi ghat, at Madapur, Napoklu and on the Paiyaswani River. Settles rather high on the leaves of low trees.

H 82. 4. *Horaga viola*, M. I have not taken it. Col. Winckworth took one at Urti at the bottom of the Perimbadi ghat. Very rare in Coorg.

H 83. 1α. *Catapoclitma elegans myositina*, Fruh. Throughout the evergreen country, but not common. It often settles on the leafless twigs or on the flowers of *Eugenia hemispherica* (?). Both above and below the ghats, and in most months.

H 84. 1. *Chilaria othona*, Hew. Is certainly one of the rare *lycanidae* in Coorg. It occurs sporadically both in the deciduous evergreen forests; e.g., at Fraserpet in January, and in the evergreen, Nalknad and the Paiyaswani River. Generally on trees or on flowers; but occasionally on damp earth.

H 86. *Zeltus etolus*, F. I first took this in December at Urti. Later at mile 155 on the Perimbadi ghat road. On the Sampaje ghat, near the Paiyaswani River, 13 miles from Mercara, ♂♂ were plentiful from February to April. ♀♀ are rare and seen to keep inside the jungle. ♂♂ settle frequently on damp earth. It appears to be confined to the thick evergreen jungle and damp heat.

H 88. 1α. *Deudoryx epijarbas epijarbas*, M. Common in Coorg, as round Bangalore, upon flowers.

H 89. 1. *Virachola isocrates*, F. Common, but not so common as the last. Taken on flowers.

H 89. 3a. *Virachola perse ghela*, Fruh. Appears to be rather uncommon in Coorg, as it is round Bangalore. Occurs in dry, intermediate and evergreen areas. Taken on trees (e.g., cinnamon) and on flowers (e.g., of a large *Ostebeckia* and a tall purple composite).

H 90. 5. *Rapala lankana*, M. A rare, if not very rare, insect, I have only seen it on the ghats or in the hot forest below the ghats. Taken on flowers (e.g., *Clausena indica* (?), and a *Cæsalpina*).

H 90. 10a. *Rapala varuna lazulina*, M. Fairly common throughout. Taken on leaves and flowers.

H 90. 11. *R. schistacea*, M. Common.

H 90. 15. *R. melampus*, Cr. I took this very commonly near Bangalore; and regret that I did not note its frequency in Coorg. It is I think fairly common.

[Note.—I have not seen any *Rapala* on the ground at water. They all seem to affect trees and bushes—feed greedily at flowers.]

H 92a. *Bindahara phocides moorei*, Fruh. This beautiful insect can be had in most months from September to May—the months of which I have experience in Coorg—in the evergreen forest of the ghats, generally near streams or rivers. It is an insect that seems partial to a locality or a particular plant: if found once on the flowers of a particular *clausena indica* it may be found there at another season. Most frequent September–October and April–May.

VIII.—Family HESPERIIDÆ

I 1. 6β. *Hasora badra badra*, M. 'Not common' (Hannington). I have looked in vain for this insect.

I 1. 12. *Hasora alexis alexis*, Fab. Common as elsewhere: throughout the province.

I 1. 13a. *Hasora taminatus taminatus*, Hub. Both above the ghats and on the ghats, in intermediate and evergreen country. It favours stones and sand by the side of streams, especially in the forest and debouching from the forest, springs by the roadside on the ghats and damp spots on the roadside. Also on flowers especially early in the morning and late in the afternoon; e.g., on lantana.

[Note.—Hannington in his list gives

263 *Hasora chabrona*, Plotz. Bhagamandala, January.

265 *Hasora badra*, Moore. Not common.

Now *Hasora chabrona*, Bl. = *Hasora villa*, But, which is not S. Indian: it is of the *badra* group. Can it be that by *Hasora chabrona*, of which he got a specimen or specimens only in January at one place he means *Hasora badra*? And that by *Hasora badra*, which he describes as not common he means *Hasora taminatus taminatus*? The latter is not common certainly, but it is not rare: and in five years Hannington could not have failed to gather more than one specimen or to have found it at only one place.]

I 2. 5x. *Ismene fergussoni*, DeN. 'Fairly common in the evergreen belt, especially in the monsoon' (Hannington). Also, after the monsoon in September–October, and again in May. I have seen it in N. Coorg beyond Sonwarpet, in the intermediate area. Flies and feeds on lantana, verbena, etc., early in the morning and towards dusk. Disappears in the day time.

I 2. 13a. *Ismene gomata kanara*, Evans. Recorded by Hannington as on the ghats during the monsoon.

I 3. *Bibasis sena sena*, M. 'Eastern Forests. Annual' (Hannington). I took on a specimen at the foot of the ghats in evergreen country.

I 5. α. *Rhopalocampta benjamini benjamini*, Guer. 'Northern forests in June and September' (Hannington). Also evergreen country above the ghats;

e.g., Heggala (October), Swamimale (February) and Kakkotpole (May). By no means common. Taken in shade on flowers and on the ground in the morning and late afternoon.

I 6. *Badamia exclamations*, Fab. Common throughout the year.

I 16. 1. *Celaenorrhinus ambareesa*, M. 'On the ghats during the monsoon' (Hannington). Also in May and September. Taken on flowers in the morning sun. Not common.

[I assume this is Hannington's *C. spilothyrus*, Felder : though I admit there is resemblance. If, however, *C. spilothyrus* really occurs, of which I have no personal record, then *C. ambareesa* is additional to Hannington's list.]

I 16, 13a. *C. leucocera leucocera*, Koll. 'Common from May to October on the western slopes' (Hannington). Also throughout the evergreen area above the ghats. Where found obtainable in other months of the year, but less commonly than in the rainy season.

I 16, 19a. *C. ruficornis area*, Plotz. 'Not common on the Periambadi ghat in September' (Hannington). It is not so common as *C. leucocera*, but is not uncommon; also in October and more rarely in other months. On other ghats also, and above the ghats in evergreen country.

All these *Celaenorrhinus* are rather shade-loving insects : flying into the open in the morning to feed on flowers, and for the rest preferring half-shady glades or openings into the forest.

I 20. 4β. *Tagiades obscurus athos*, Plotz. Throughout the intermediate and evergreen country 'annual' (Hannington).

I 20. 9 x. *Tagiades litigiosa vajuna*, Fruh. Throughout the intermediate and evergreen areas. Annual. [*Tagiades alticus* : in the bamboo (South Coorg) and ghats (Hannington)].

I 24. 3a. *Daimio bhagava bhagava*, M. I give this with hesitation. Hannington includes *Satarupa bhagava*, Moore : Eastern forests ; May to October. I am unable to identify this. I have not taken it : Col. Winckworth has *Daimio bhagava* from Kallar (Nilgiris).

I 25. 1a. *Coladenia indrani indra*, Evans. '*Coladenia tissa*, Moore. Pushpagiri, May : Fraserpet and Titimati, July and August (Hannington). Also in the ghats and above the ghats in February, March, April and September. In September 1928 a ♀ taken has cilia *hw* not white but brown and fawny. This insect is also found round Bangalore.

I 25. 2 a. *Coladenia dan dan*, Fab. Common throughout Coorg and at all seasons. It does not occur, so far as I know, in the dry jungles round Bangalore.

I 26. 2. *Sarangesa purendra*, M. 'November to January' (Hannington). I have not taken it in Coorg and do not know its locality.

I 26. 3 β. *Sarangesa dasahara davidsoni*, Swin. 'June to September' (Hannington). It certainly occurs after September, till May. Annual and common in the evergreen area at least.

I 28. 1 β. *Tapena thwaitesi hampsoni*, El. 'One male on May 8, at Srimangala, S. Coorg' (Hannington). Rare but obtainable at several places, in evergreen areas above and below the ghats. At Watecolli in September 1928 (♂, ♀) on flowers of *ramtulasi* (verbena). February to March at Ajjemada stream, below the Brahmagiri range ; January to April on Sampaje ghat (13½ miles from Mercara) and on Paiyaswani River ; and May at Kakkotpole (Marinad crossing). Like *Odontoptilum angulata* and *Caprona ransonnelti* favours damp earth, on which it lies with spread wings. I have seen it, whether by chance or by instinct for self-protection, several times settled on damp black camp ashes, where bullock drivers had stopped.

I 31. 1. *Odontoptilum angulata*, Fd. 'Eastern forests, May to September' (Hannington). It occurs also at many places in the intermediate and evergreen

areas, and is widely distributed and even common; obtainable every month from September to May, probably annual. Settles with flat wings on damp earth on roads and by streams.

I 32. 1 *a*. *Caprona ransonnetti poliphra*, Hew. 'May to October' (Hannington). It occurs throughout the province from the deciduous to the evergreen area and is, so far as I have observed, to be had in any month between October and May. Like the last two in its habits. Common in Coorg. Rare round Bangalore.

I 34. 1. *Hesperia galba*, Fab. 'Annual' (Hannington). Common: low-flying in the sun on grass and on low flowering plants.

I 54. *β* *Astictopterus jama olivascens*, M. Not given in Hannington's list. Occurs in both W.S.F. and D.S.F. the latter in January and February or probably earlier, at Mercara. I have not seen it outside the evergreen area. A relatively weak flier: flies low along banks.

I 56. 2. *Baracus hampsoni*, El. 'Annual' (Hannington). Is there a D.S.F.? I have taken fresh specimens in the drier months that are not bright ochreous brown below, but an ochreous grey.

I 57. 1. *Ampittia dioscorides*, F. 'Eastern forests, May to September' (Hannington); also in the intermediate and evergreen country at other seasons, e.g., Somwarpet (intermediate) in January and Watecolli (evergreen) in May.

I 58. 5 *a*. *Aeromachus pygmaeus pygmaeus*, Fab. 'Annual' (Hannington). It may be added very common and in all areas.

I 60. 1. *Arnetta vindhiana*, M. 'Annual' (Hannington). It appears to be found chiefly on the ghats, also at Mercara.

I 61. 2 *a*. *Iambrix salsala luteipalpus*, Plotz. 'Annual' (Hannington). Universal, throughout the province; flies low in clearings, round bushes and under trees; settles on flowers.

I 62. 1 *a*. *Suastrus gremius gremius*, F. 'Annual' (Hannington) and common; well distributed.

I 62. 3 *a*. *Suastrus rama bipunctus*, Swin. 'Annual but not common' (Hannington). I have not taken it in Coorg.

I 67 *a*. *Sancus pulligo subfasciatus*, M. 'Western slopes in the Monsoon' (Hannington). It is very common then and afterwards up to October, but occurs less abundantly later up to May. Annual. Frequents flowers, e.g., *Rantulasi* and *lantana*. A rather floppy flight on the edge of the jungle. Belongs to the evergreen area.

I 73. 1. *Udaspes folus*, Cr. 'Annual' (Hannington). Found in all areas. Flies low, in and round bushes and under trees. Frequents flowers and comes freely to water, on stones, etc., by the side of streams.

I 74. 3 *a*. *Notocrypta paralysos alysia*, Evans. Abundant at times, e.g. after the Monsoon, September and October. Chiefly in the evergreen area. 'Annual' (Hannington).

I 74. 5. *N. curvifascia*, Fd. Flies with the last, but is much less common.

I 75. 1 *β*. *Gangara thyrsis thyrsis*, F. 'S. Coorg and the ghats in the monsoon' (Hannington). It occurs again towards the end of April. I have taken it in October also.

I 80. 1. *Matapa aria*, M. 'Not common, but widely distributed' (Hannington). Flies inside or on the edge of jungle; occasionally on flowers. Taken in October, January, March and May; all in evergreen country.

I 82. 1 *β*. *Hyarotis adrastus adrastus*, Cr. 'S. Coorg and the ghats in the Monsoon' (Hannington). Also, immediately after the Monsoon. It is then commonest, but occurs in other months, e.g., January to May. Generally on flowers on the edge of jungle, and in the half shade.

I 82. 2. *Hyarotis basiflava*, DeN. Hannington says he found this fairly common in September 1913 on the flowers of *Stribilanthes barbatus*. 'As this strobilanthes is reputed to flower only once in 7 years, possibly this butterfly will

escape observation till 1920'. In 1927 it was taken (one specimen on *Ram tulasi* (verbena) at Watecolli.) In 1928 September I took a couple at Watecolli in the early morning expanding their wings on the leaves of a cinnamon tree, and several on the Perimbadi ghat near mile 152 on *Ram tulasi*. *Strobilanthes* grows near both spots, but was not in flower. The butterfly disappeared afterwards. I should say it is very rare in Coorg.

I 83. 1. *Itys microstictum*, WM. 'Now *Kineta*', (Evans). I took two ♂♂ and one ♀, which Evans kindly identified for me. The ♀ I took early one morning in April 1929 sunning its wings near mile 13 from Mercara on the Sampaje ghat; a ♂ flew away into the forest. Later on about 1 p.m. I took a ♂ feeding on the flowers of *clausena Indica* (?) in the shade. A few days later I took another ♂ feeding also on the same flowers in a stream leading up from the old forest tramway to Solekolli from Urti (Perimbadi ghat), also in the shade. Evans writes in his note: 'Hitherto only recorded from Cachar, Burma, etc. Always very rare and very variable. I have only a few specimens and I have more than in any museum. The ♂ corresponds very well with one of my ♂♂ from the Ataran valley but the ♀ is curious in having the spot over the middle of the cell so strongly developed: in only one of my ♀♀ is there any more than a trace of it. However there is no doubt about the identification. Swinhoe redescribed it as *Arnetta binghami*. *Itys* is preoccupied and has recently been replaced by '*kineta*' I have given ♀ and ♂ to the British Museum.

I 87. 7 a. *Plastingia submaculata kanara*, Evans. I wonder if this is what Hannington names *Pedestes sala*, Hew (Yes, Ed.). I am unable to trace *pedestes sala*, whereas *Plastingia submaculata kanara*, Evans belongs to the *sala* group of *Plastingia*. I took one specimen at Watecolli in May 1928; Col. Winckworth has another specimen taken in October. I missed another at Watecolli. It is evidently a rare butterfly: I made repeated efforts to get another, but failed. The one I caught flew out of an opening into dark forest and was feeding on lantana after dusk, when *Ismene fergussoni* was also feeding.

I 99. 4. *Halpe hyrtacus*, DeN. 'Western ghats' (Hannington). In September and October (1927-28) it was fairly common at Watecolli on lantana and *rantulasi*; I fear I neglected opportunities, not realizing its rarity. I have taken it on the Sampaje ghat (13½ miles from Mercara) in January and again at Watecolli in April.

I 99. 8. *Halpe sitala*, DeN. 'Nagarhole, eastern forests in May: one specimen' (Hannington). I have not seen it.

I 99. 15. *Halpe astigmata*, Swin. 'Western ghats in the monsoon' (Hannington). It is almost abundant on lantana, etc., after the monsoon in September and October; and occurs also later in January and on till May; in the last month it becomes common again. Found also above the ghats in evergreen country.

I 99. 22. *Halpe honorei*, DeN. Widely distributed from the eastern forests to the evergreen; occurs in North, Central and South Coorg. Hannington gives only the Western ghats. I do not know about the monsoon months, but it is to be had every other month, but is at no time common.

I 99. 26. *Halpe moorei*, Watson. 'Annual' (Hannington). I have one specimen, taken in Malambi forest, N. Coorg in May.

I 99. 33 a. *Halpe homolea ceylonica*, M. 'Western ghats' (Hannington). It is widely distributed throughout the evergreen and intermediate areas, above and below the ghats, and occurs throughout the year. It is, I think, the commonest *Halpe* in Coorg.

I. 103. *Cupitha purreea*, M. Not in Hannington's list. It is one of the rarities in Coorg. I have seen it only in evergreen woods, Madapur (N. Coorg): Watecolli, Makut (below the ghats) and Sampaje ghat. In each case I took it on flowers.

I. 104. 1. *Nicevillea concinna*, El. 'I have only come across this on the Western slopes in the monsoon' (Hannington). My captures were in September and October just after the monsoon.

I 104. 2. *Nicevillea gola*, M. 'Annual' (Hannington) and common: widely distributed. Commonly taken on leaves, sunning itself; also on flowers.

I 105. 2 β . *Taractrocera mævlus flaccus*, F. 'A single specimen near Fraserpet in August' (Hannington). It occurs in many places, in all areas, and in other months—e.g., Watecolli in May. Fairly common.

I 105. 4 α . *Taractrocera ceramas ceramas*, Hew. Not in Hannington's list: obviously an oversight. It occurs commonly in open grass country, e.g., on the grassy slopes of the hills, Tadiendamolu, etc.: certainly from September onwards.

I 106. 7. *Padraona dara pseudomaesa*, M. 'Annual' (Hannington) and very common throughout year.

I 106. 8 β . *Padraona sunias tropica*, Plotz. Common and annual. The variety *palnia* (Evans) occurs. This and *Pseudomæsa dara* are everywhere; they settle on leaves and spread their hind wings, keeping the fore wings more or less erect.

I 108. 1. *Telicota augias augias*, L. 'Annual' (Hannington). Not nearly so common as the next.

I 108. 2 α . *Telicota pythias bambusæ*, M. Common in Coorg as elsewhere.

I 115. 1 β . *Baoris oceia farri*, M. Presumably Hannington's '*Parnara plebeia*, DeN. Annual.' Fairly well distributed through the evergreen country, but not common.

I 115. 5 α . *Baoris sinensis subochracea*, M. (= Hannington's '*Parnara prominens*, M. Western slopes, August.') It also occurs above the ghats; I have one damaged specimen from the Eastern forests, and several from Aggemada stream. This *Baoris* comes freely to water, and settles on stones. It is rare in Coorg.

I 115. 6 γ . *Baoris mathias mathias*, Fab. The larger dark form *agna* occurs abundantly on lantana, etc., on the ghats after the monsoon and occasionally later. Very common and annual.

I 115. 14 β . *Baoris kumara kumara*, M. 'Annual' (Hannington). Occurs throughout the province from dry to evergreen, but is commonest in the evergreen country.

I 115. 15 β . *Baoris philippina philippina*, HS. Not in Hannington's list. It occurs in the evergreen country and occasionally in the intermediate. Is undoubtedly rare: chiefly in September and October, in my experience; on the ghats on flowers.

I. 115. 18 α . *Baoris conjuncta narooa*, M. [Hannington's '*Parnara conjuncta* HS. Western slopes, August.']. It occurs on the ghats also in September and October; also December to February: and above the ghats at Irpu and Ajjemada stream in February and March; at Mercara in May; Fraserpet, May. Thus it is found in all areas. Comes out of the jungle early to feed and then disappears inside. Comes out again in the late afternoon.

I 115. 23. *Baoris contigua*, Mab. (= Hannington's *Parnara toona*, M. 'Annual'). It is distinctly rare, I think, in Coorg. It occurs on the ghats and above the ghats, so far as my experience goes, only in evergreen country. Taken only on flowers.

I 115. 28 β . *Baoris guttatus bada*, M. 'Annual' (Hannington), and fairly common; throughout the province.

I. 115. 29. *Baoris canaraica*, M. 'Western slopes, May-August' (Hannington). I have it from other areas and in other months. Above the ghats from beyond Somwarpet in N. Coorg; from Irpu and Ajjemada stream (S. E. Coorg); from Ponnampet in the intermediate area. The form which occurs from January to March (early) differs from the monsoon or W. S. F. (See *Journal of B. N. H. S.*, vol. xxxiii, No. 4, p. 1000, note by Evans on specimens

sent him from Coorg.) This butterfly does not fly much in the open after 10 a.m. It comes out of the forest on a dewy morning, expands its wings on leaves in the sun and flies back again; but feeds on flowers such as *Ram tulasi*. I have, however, taken it when cloudy on the ghats in the middle of the day.

I 115. 30 β . *Baoris zelleri colaca*, M. 'Annual' (Hannyngton) common as elsewhere, e. g. round Bangalore.

I 115. 31 β . *Baoris bevani bevani*, M. 'Annual' (Hannyngton). But both Col. Winckworth and myself failed to get it for a long time. For two years I had been in hopes, but always failed. Eventually I got it without doubt at Ajjemada Stream (under Brahmagiri Hills) in February and March: probably it is there in other months. It appears to be a retiring insect. It flitted up and down a rocky and shady stream, settling on stones where there was a patch of sun. One or two came out into the open at the debouchment of the stream from forest into cultivated land; where also *Baoris subochracea*, *Baoris conjuncta*, *Baoris canaraica*, *Tapena thwaitesi* and *Horsfieldia anita*—to mention only a few of the more desirable species—emerged. In my experience *B. bevani* is rare in Coorg, whatever it may be elsewhere.

THE PROBLEM OF EVOLUTION

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PART I

EXPERIMENTAL MODIFICATION OF BODILY STRUCTURE.

The problem of evolution is one that has, within recent years, attracted the attention of numerous workers in very different branches of scientific research. It is a problem that affects the Chemist and Physicist equally as much as the Botanist or Zoologist or even the Psychologist, and if ever the problem is to be solved, it will require the combined efforts of all these workers.

What then is life? It does not usually require any very great knowledge or ability to tell whether a thing is living or not; but bound up in the act of living are a number of different and often complicated processes. All the possibilities and potentialities of the most complex animal or plant are inherent in and originate from the smallest and most primitive member of the great biological kingdom. A living organism, whether it be as small as an *amœba* or as large as a whale, is capable of carrying on such complicated changes as are necessitated by—

- (1) The ingestion or taking in of food;
- (2) The digestion or the preparation of food that has been ingested, thus rendering it suitable for
- (3) Assimilation or the building up of the materials derived from the food into the tissues of the animal;
- (4) Respiration or the taking in of Oxygen and the giving out of Carbon Dioxide gas;
- (5) Irritability or the reception and transmission of impulses and sensations;
- (6) Movement, either of the animal as a whole or of its integral parts;
- (7) Excretion or the getting rid of waste products; and
- (8) Reproduction or the carrying on of the race.

All these functions are performed by the substance that we know by the name 'Protoplasm' and, so far as we know, each mass of protoplasm, if it is to perform all these functions, must contain a small central body termed a nucleus. Now protoplasm is a highly complex chemical substance consisting of an aggregate of molecules

and these in turn are built up of atoms. Each atom consists of a number of ions in a state of constant movement, and certain Physicists¹ have reached the conclusion that life originates from a dual system of these ions. As one of them describes it, 'certain ions assume an intra-atomic position, thus forming an immaterial Z-system which is incapable of chemical combinations; the other enveloping ions constitute the material Y-system, the development of which is controlled by the immaterial Z-system which leaves the material one at death. Living matter is invariably of dual constitution In the living organism, life is an intra-atomic quantity and it is this which determines the living state The possibilities of the evolution of any forms that arise are strictly limited. Most existing species would be only specific and fixed in essentials, since the limit of their evolution was reached long ago, because of the constitutional limitations of reactions possible to a life form. When this limit is reached the species becomes fixed.' That is a summary of the conclusion reached by a Physicist and whether we understand it or not, there are but few Zoologists, I imagine, who would be inclined to admit that the majority of species have reached the limit of their evolution; let us, however, examine such evidence as we possess regarding the possibility, or the reverse, of such a statement being correct.

Commencing from the first living organism, there has been an uninterrupted line of descent till we reach the present forms that are inhabiting the world to-day. As has been pointed out, the son is not merely 'a chip of the old block'; he is a direct descendant not only of his father and grandfather but of the very earliest forms of animal life. Species are *not* discrete forms of life; they are, on the contrary, portions of a continuous stream or flow that has been going on through countless ages in the past and may continue to go on through the future; from time to time the direction of the stream has been changed and has split into two or more channels but there has been no break in the continuity.

One of the first stages in the course of evolution was the change from the non-cellular to the multi-cellular state and the consequent formation of a body. Specialization of function, however, had appeared in the animal kingdom long before this cell-formation, for in the non-cellular organisms we get evidence of definite organs, such as a mouth, motile organs, such as flagellæ and cilia, excretory organs, as the contracting vacuole, and a controlling centre, the nucleus. What then was it that caused so fundamental a change as that from the non-cellular state to the multi-cellular condition? These non-cellular organisms, the Protozoa, normally undergo growth and development and then by a process of fission give rise to two or more daughter cells that separate and in their turn grow and divide; and one suspects that some change occurred either in the animal itself or in its surroundings that led to the inability of the daughter cells to separate and thus, with a loss of independence, gave rise

¹ 'What is life?' by Augusta Gaskell, with an introduction by Karl T. Compton and Raymond Pearl. Published by Charles G. Thomas, Springfield, Illinois, 1928.

firstly to a multinucleate protoplasmic mass, or syncytium, and then to a colony of cells, which is the first stage in body-formation. Such a syncytial condition is actually met with in nature among the Protozoa. In these, as in other higher animals, the control of the functions of the cell rests ultimately with the nucleus and there is a direct relationship between the nucleus and the cell mass. In the more primitive forms we find a single nucleus in the animal. though in more advanced forms we may get two or more nuclei in the single protoplasmic mass; in other words these forms are *syncytia*. As a rule the cell mass and the number of nuclei have a very definite proportion; though this proportion may change at different stages in the life history or in different external conditions, such as variation of temperature or increase of food. As evidence of this I may cite the work of Popoff¹ on *Paramacium* and that of Looper² on *Actinophrys*. If now in such an animal the amount of nuclear material, which may be in the form of one or more nuclei, be upset, the amount of protoplasm in the animal, and hence its total size will, as a rule, be altered in a corresponding ratio, though this ratio may for a time be upset. Henger³ has shown that in *Arcella dentata*, a Protozoon with normally two nuclei, one nucleus can be removed. On reproduction taking place, individuals with only one nucleus are produced and the animal is of smaller size, and, furthermore, such individuals appear for several generations. This result is particularly interesting for we appear to have here a definite temporary transmission of an acquired traumatic character. The condition is not, however, permanent, for ultimately the bi-nuclear form will be restored by a process of aborted fission, the nucleus undergoing division but not the protoplasmic mass itself, so that we again get two nuclei in the one animal and now the size of the animal is found to be larger than the original bi-nuclear ancestor, but this condition also only persists for a time and ultimately the size becomes normal again. Comparable results were also obtained in *Arcella discoides*. A similar result has been obtained in one of the primitive plants, *Spirogyra bellis*, under the influence of cold, some of the cells becoming greatly increased in size and possessing enlarged nuclei; and such cells have bred true for over a year.⁴ This change in the relationship of nucleus and cell mass is however not universal, for it has been found by Burnside⁵ that biotypes of unequal size are not produced by inequalities in the amount of nuclear material in *Stentor*

¹ Popoff, M. 1909. 'Experimentelle Zellstudien, II Über die Zellgrösse, ihre Fixierung und Verebung.' *Arch. f. Zellforsch.*, Vol. iii, p. 124.

² Looper, J. B., 1928. 'Cytoplasmic fusion in *Actinophrys sol.* with special reference to the Karyoplasmic rates.' *Journ. Exper. Zool.*, Vol. i, p. 31.

³ Hegner, R., 1920. 'The Relations between Nuclear Number, Chromatin mass, Cytoplasmic mass, and shell characteristics in four species of the genus *Arcella*.' *Journ. Exper. Zool.*, Vol. xxx, p. 1.

(A number of further references to this subject are given in the three papers quoted above. *R.B.S.S.*)

⁴ Gerassimoff, J. J., 1902. 'Die Abhängigkeit der Grösse der zelle von der Menge ihrer Kernmasse.' *Zeitschr. f. allg. Physiol.*, Vol. i, p. 220.

⁵ Burnside, L. H., 1929. 'Relation of body-size to nuclear size in *Stentor caeruleus*' *Journ. Exper. Zool.*, Vol. liv, p. 473.

caruleus. That a tendency towards incomplete fission of a parent cell and the consequent formation of a large or "monstrous" form, with an increased cell mass and an excess of the normal number of nuclei, exists in nature can be proved by traumatic injury of an individual or by the effect of drugs, X-rays, or overcrowding on cultures of these non-cellular animals; in such cases we get the production of monstrous forms in which two individuals are partially fused together in consequence of incomplete fission, or even of an apparently normal single cell with double the normal number of nuclei and a consequent increase in the bodily size. Even without the direct application of any abnormal condition such individuals may occur and it has been recorded that in a culture of a protozoan, *Uroleptus mobilis*, on one occasion two individuals came together in the normal process of conjugation but after the usual interchange of nuclear material, when, as a rule, the individuals again separate, this separation did not take place and the result was the formation of a double or monstrous form. This double individual subsequently underwent division and bred true, the offspring also being double, for as many as 367 generations.¹ Similar examples of double organisms have been recorded in *Glaucoma scintillans* by Chatton² and in an amiconucleate *Oxytricha* by Dawson.³ In this latter case twinning occurred in a normal culture and from these twins a pedigree strain was bred for 102 generations before the culture died out.

It thus seems probable that the first stage in the process of evolution was that in which the nucleus of the cell undergoes division but the protoplasm of the animal body is unable to form isolated cell masses. This syncytial condition is met with in the ectodermal layer of the sponges and is found even as high in the animal scale as the birds, in which the earliest formation of the developing ovum is also a syncytium. Still later, the condition is reached in which the body is composed of separate and discrete cells, and we get the formation of a colony.

Associated with the change from a syncytial condition to the cellular state there was of necessity a radical change in the conditions of life under which certain members of the colony live. Now the first essential of any body is that it must have a definite shape and structure. In the very lowest of the Metazoa this shape tends to be a sphere. Commencing from a single cell, subsequent division into numerous daughter and granddaughter cells, that may spread in any direction unless restrained by contact with some foreign object, is bound to give us this type. The first stage was thus in all probability

¹ Calkins, Gray N., 1925. '*Uroleptus mobilis*. V. The history of a double organism.' *Journ. Exper. Zool.*, Vol. xli, p. 191.

² Chatton, F., 1921. 'Rèversion de la scission chez ciliés. Réalisation d'individus distomes et polyenergide de *Glaucoma scintillans* se multipliant indéfiniment par scissiparité.' *Conts. Rend. Acad. Sci.*, Vol. clxxiii, p. 393.

(I have not been able to refer to this paper *R.B.S.S.*)

³ Dawson, J. A., 1920. 'An Experimental study of an amiconucleate *Oxytricha*. II. The Formation of double animals or twins.' *Journ. Exper. Zool.*, Vol. xxx, p. 129.

the production of a more or less spherical mass in which all the cells were situated on the periphery, the interior of the colony being hollow. Such a condition is found to-day in the animal *Sphærozoum* and in *Volvox*, that is claimed by both Zoologists and Botanists. As soon as a colony becomes solid there is of necessity a differentiation of function. With the increasing organization of the animal body certain parts take on definite functions and for the proper performance of these it is necessary that the parts occupy certain equally definite positions in the body. Clearly, those cells that are situated on the outside are in a position to receive stimuli from the surroundings or to capture food particles, take up the gases necessary for life, etc., while those in the centre of the mass are completely cut off from these functions. In accordance with this change in conditions we find a differentiation of function in the constituent parts of the body-mass; one group of cells, connected with the exterior, takes on the function of receiving and transmitting stimuli; another group of cells becomes adapted to the performance of movement and are known as muscle-cells, others take on the function of support, for a colony or body of any size must have some supporting mechanism; another group of cells takes over the process of digestion, while others again serve the function of excretion. Finally, we get one group of cells whose sole function is that of reproduction and the maintenance of the race. With this formation of a body there goes hand in hand the absolute necessity for the formation of discrete cells, each having a definite surface area. The cells of the body continue to perform many of the functions that we have seen to be inherent in Protoplasm, namely, assimilation, response to stimuli, movement, and excretion. All this activity necessitates the continual taking in of oxygen and the giving out of carbonic acid gas, to wit, respiration, and this process, as well as the taking in of food and the giving out of dissolved excreta, can only be carried out through the surface of the cell. There must, therefore, be a certain definite square area of surface for every cubic unit of cell-substance; and we seem here to have an explanation of the fact that all such cells are of small size.

If, now, we compare the conditions of life of the various groups of cells in the body with the primitive non-cellular animals, one cannot fail to see that, associated with their specialization of function, there has gone, not only a loss of independence, but a gradual loss of certain powers; and it is this loss of function that I wish to emphasise. The first power that most, if not all, of these groups have lost is that of digestion; originally digestion took place within the cell, the food particles being ingested and then digested, but in the higher multicellular animals even the stomach cells or those of certain glands intimately connected with the process, such as the salivary glands or the pancreas, only produce the digestive ferments, the actual process of digestion being carried on outside the cells themselves in the cavity of the stomach and intestine. Again, with the exception of the genital cells, all the others have lost the power of continuous reproduction, since this is, apparently, dependent on occasional conjugation with a similar cell from another colony, or in the higher animals with fertilization between the ovum.

and spermatozoon. The result of this loss of function is that these specialized cells can only reproduce their kind for a limited time. As you are all doubtless aware, tissues can now be grown and cultivated *in vitro* in the same manner as bacteria, and it has been shown that under such conditions the cells continue to reproduce by what is known as the amitotic method.¹ The time during which such a tissue culture may be continued may actually exceed in duration the normal period of life of the animal itself, but whereas the life of the animal can be transmitted to its offspring, that of the culture must ultimately come to an end.

The essence of reproduction is the ability to initiate and subsequently to direct the differentiation of the daughter cells that result from the continued division of the parent cell. This process, which in the highest members of the animal kingdom resides solely in the genital cells and has been completely lost in all the others, was not lost suddenly. In many of the lower animals we still get the power of reproducing the whole animal from a small part, and in such comparatively highly organized animals as the Crustacea or even the lower Vertebrates we still find the capability of reproducing lost parts.

During development in the higher animals, the ovum divides and re-divides and these resulting daughter-cells have an ultimate destiny that under normal conditions is definitely fixed. From the cells of the 'blastula' stage arise the three primary layers, Epiblast, Mesoblast, and Hypoblast, and each of these, as we know from our observations, gives rise to definite parts of the body and serves definite functions; epiblast is essentially the layer from which is derived the outer covering of the body and the organs of the senses; mesoblast gives rise to the muscles of the body and the supporting skeleton; and hypoblast forms the digestive organs. Under normal conditions there is a definite polarity in the ovum from which the body is developed, certain parts of the egg-cell giving rise to definite structures; in certain cases this polarity clearly depends on the position of the egg and is the result of the interaction of a number of forces, conspicuous among which is gravity. One very good example of this is to be found in the egg-capsules of the common cockroach (*Periplaneta australis*). In this animal the female lays a capsule containing 16 eggs arranged in two rows and as development proceeds these eggs all develop in exactly the same way; the embryo is always situated from the very first with the head towards the crenated ridge that runs along the top of the capsule and the ventral aspect of the larva is turned inwards towards that of the corresponding larva on the opposite side of the capsule. It seems clear that this fixed position is due to the forces acting on the egg, for one can hardly suppose that the mother cockroach invariably places all the separate eggs in exactly the right position. It has further been shown that in the very early stages of development out of the original four cells produced by the division of the ovum two can be destroyed and yet the other two

¹ Murray, Margaret R., 1927. 'Cultivation of Planarian Tissue,' *Jour Exper. Zool.*, Vol. xlvii, p. 467

will give rise to a complete and perfect animal, while in one of the mammals, an Edentate, the nine-banded Armadillo, a female at each litter produces four offspring, all identical and of the same sex, each having arisen independently from one of these four cells.¹ It is thus clear that even the polarity of the egg is not absolutely fixed and this seems equally to be the case even in the highest forms, for Newman² in his studies on Twins has shown that in the human being the fixation of the body-form does not exist in the ovum but is developed at some stage after the development of the egg has begun. But it appears probable that this fixation occurs at an ever earlier stage as we pass up the animal scale.

There can, I think, be little doubt that among lower animals the developing body is influenced by its surroundings to an extent that we, at the present time, but dimly appreciate, and this was probably still more the case in the past among the lower organisms, in which the body was and is far more plastic than it is in higher animals. Can anyone, who has studied the work of Loeb and his school, doubt that the general shape of the body is *not* a matter of haphazard mutations, some of which proved to be favourable, while others were unfavourable and so were ultimately destroyed by natural selection, but is due to the action on the organism of definite forces and influences? I have already pointed out that differentiation of the body into various organs is met with in the lowest animals, such as the Protozoa. When such animals reproduce by fission into two there is a differentiation of the protoplasm into such organs as the animal possesses, so that each daughter-cell is fully provided with mouth, nuclei, excretory organs, and the like, but we also in these animals meet with the exact opposite phase for a process of dedifferentiation is carried out both before conjugation and also before encystment, and in this phase the gullet, the vibratile membranelles, and other structures tend to disappear. Such dedifferentiation may also occur spontaneously in a culture, to be followed again by redifferentiation, the animal once more reforming its lost parts. In somewhat higher animals this process becomes even more striking. Let us take the case of the Hydroid *Campanularia*; if this animal be brought in contact with a solid substance it shrinks up into a shapeless mass, but if it be then restored to its natural surroundings it once again reforms itself into stalk, body, tentacles, etc., and whichever way one turns the shapeless mass the final product is the same, the stalk is at one end and the tentacles at the other. We thus get a new *Campanularia* whose structure and parts are not due simply to its internal organization but are so much a direct reaction to external forces and conditions that the point where the re-growth shall begin may be fixed at the will of the experimenter. The change is not a mere reversibility from a fully-formed animal to a blastula or syncytium but is a completely new process. Again in an animal such as *Hydra*, which normally has a mouth at one end and a base at the other, we can by altering the

¹ Pearce, A. S., 1929. 'General Zoology' Revised Edition, p. 291, New York.

² Newman, H. H., 1928, 'Studies of Human Twins,' *Biol. Bull.*, Vol. 1y.

position of the animal reverse the formation or even produce a double condition, there being a mouth at each end. Similar results have been obtained in other members of the Hydrozoa, such as *Corymorpha*. In this latter animal, a cut piece of the stalk will normally regenerate a head and tail from opposite ends of the cut piece with the head up and the tail down, so that there would at first sight seem to be a definite polarity. Child,¹ however, has shown that if a piece of the stalk be treated with certain chemical reagents of a strength sufficient to inhibit growth but not to kill the organism, this polarity is upset and on being returned to normal conditions heads and tails may appear in almost any direction and even from the middle of the growing portion. Very similar effects have, again, been produced by Julian Huxley² on the developing larvæ of certain Echinoderms; he has shown that the effect of transitory immersion in weak solutions of certain poisons, such as KCN, ZnSO₄, Hg-salts, etc., or even starvation, may produce dedifferentiation, the larva losing its characteristic shape and degrading into an unmodified mass of cells. If this mass be then removed from the harmful solution before the process of poisoning has gone too far and is again placed in sea water, redifferentiation into a normal larva with its various structures is possible. This process of dedifferentiation and redifferentiation of the body is in certain cases a normal process and has been brought to a high degree of perfection in the Insecta, where we find that during the pupal stage such changes take place in most of the different parts of the body, so that the structure of the final adult animal, the imago, is very different from that of the larval stage, the caterpillar.

We can, however, carry matters further than this. The work of Wilson³ and others has shown that in the sponges the animal can be broken up into its constituent cells, by first mincing finely and then straining the resulting fragments through a fine sieve, and yet these individual cells will subsequently come together again and will actually unite to form a sponge once more. Similar experiments performed on Hydroids, such as *Pennaria tiarella* and *Eudendrium carneum*, show that the individual cells first unite to form an undifferentiated mass and from this mass a complete regeneration of the animal takes place, both ectoderm and endoderm being reformed. In this re-formation of the animal it has been shown that the most primitive type of cell, the amoebocyte, can reproduce most of the other types of cells, whereas such specialized cells as the desmocytes and choanocytes can only reproduce their own kind. In certain cases, such as in *Moniezia*, it has been shown by Child⁴ that the de-differentiated cells can actually become converted into germ cells.

¹ Child, C. M., 1927. 'Modification of Polarity and Symmetry in *Corymorpha palma* by means of inhibiting conditions and differential exposure.' *Journ. Exper. Zool.*, Vol. xlvii, p. 243.

² Huxley, J., 1922. 'Dedifferentiation in *Echinus* larvæ and its relation to Metamorphosis.' *Biol. Bull.*, Vol. xliii, p. 210.

³ Wilson, H. V., 1911. 'On the behaviour of the dissociated cells in Hydroids, Alcyonaria and Asterias.' *Journ. Exper. Zool.*, Vol. xi, p. 281.

⁴ Child, C. M., 1906. 'The development of germ cells from differentiated somatic cells in *Moniezia*.' *Anal. Anzieger*, Vol. xxix.

Further research along such lines has shown that the regeneration of the animal after dissociation is actually specific in character, thus if the cells of two different species such as those of *Microciona* and *Stylotella* are mixed, the cells of each species will coalesce but not those of different species, thus cells from *Microciona* will unite with other cells from *Microciona* but not with cells from *Stylotella*.¹ There would thus appear to be a definite attraction between cells of the same species, so that they tend to unite together and under the influence of the external surroundings this union must be carried out in a perfectly definite manner.

As we pass up the scale of the animal kingdom we find that this power of dedifferentiation and redifferentiation and hence the power of regeneration of parts of the body is gradually lost. For a full account of this interesting phenomenon of regeneration I would refer the reader to the exhaustive work of Korschelt.² In many of the higher invertebrates and even in the Amphibia and Reptilia of the vertebrates there still resides the power to regenerate parts that have been lost, though in the case of the more evolved forms this seems to be limited to the external structures, such as the limbs in certain Amphibia or the tail in some of the lizards, but when we arrive at the highest vertebrates all that the animal is usually able to do is to heal the damaged part by the formation of scar tissue. Yet even in these higher states of life we find that there still resides in the developing embryo a certain power to form organs and parts from cells that normally would not give rise to them. It has been shown that in the developing larva of *Amblystoma punctatum*, the normal ear, as in all vertebrates, develops from an otic vesicle that is budded off from the brain; if, however, this otic vesicle be removed, the tissue round the site, that normally would take no part in the formation of the ear, can to some extent take the place of the vesicle that has been removed and forms an ear of sorts, while if the vesicle be transplanted to some other part of the body, it undergoes much less development than in the normal situation, though it still develops into an ear.³ Again if the developing optic cup, which is also an outgrowth of the brain be transplanted to the thorax or abdomen, the skin over it will form a lens. There is thus some reaction between the various parts of the body that has a direct influence on the development of the various organs, the presence of one organ causing a characteristic development of the cells in the immediate neighbourhood; such a process is known by the name 'correlative differentiation.'

As evolution proceeds there has been acquired a stability or fixation of the bodily form so that the developing embryo is but little, if at all, affected by gravity or other normal external conditions: there is thus a definite arrangement of organs and structures,

¹ Galtsoff, Paul S., 1925. 'Regeneration after dissociation, I, Behaviour, of dissociated cells of *Microciona prolifera* under normal and altered conditions.' *Journ. Exper. Zool.*, Vol. xlii, p. 183.

² Korschelt, E., 1927. 'Regeneration und Transplantation.' Berlin.

³ Kaan, Helen W., 1927. 'Experiments on the Development of the ear of *Amblystoma punctatum*.' *Journ. Exper. Zool.*, Vol. lxvi, p. 13.

so that in examples of any given species there is but little variation and the organs do not encroach on one another. The mechanism that thus controls the character of the individual parts is generally supposed to be the production within the developing body itself of certain chemical substances, known as Hormones, that circulate in the blood and control all the various developing masses. In the Crustacea it has been shown that growth is not uniform throughout the body but that certain parts grow more rapidly than others and that the rate varies in the two sexes. These Crustacea, which develop by a series of moults, are particularly suitable for a study of this kind, involving the accurate measurement of the various parts of the body and limbs and a mathematical analysis of the proportions in each succeeding stage. In the Copepoda the most rapid growth in the body occurs at a level of the 3rd segment of the abdomen and from this point the rate of growth becomes less as we pass either forwards to the cephalothorax or backwards to the furcal rami. In certain appendages of the crabs *Uca* and *Maia*,¹ we find similar areas of rapid growth or, as they are termed, growth centres near the tips of the thoracic appendages. Similar results have been obtained in the crab *Inachus* by Shaw;² by Tazelaar³ in the appendages of the Indian prawn, *Palæmon carcinus*, and by Kunkel and Robertson⁴ in the Amphipod *Gammarus chevreuxi* Sexton. In the Copepoda again the main growth centre in the 1st antenna is situated at about one-third of the length of the appendage, namely in the 9th or 10th segment. The increase in size, or 'heterogonic' growth, is found to differ in the two sexes and is associated with the development of the secondary sexual characters and in such cases we appear to have two factors at work, the ordinary hormone that controls development in both sexes and a sexual secretion that modifies the degree of development in either sex.

From the evidence that I have put before you, and I may perhaps here be permitted to point out that I have only given you a fraction of all the evidence that has been accumulated during the past few years, it would seem clear that the development of an animal is dependent partly on external influences and partly on internal conditions and the cases that we have been considering point to the conclusion that in the lower animals it is the external conditions that exhibit the greatest influence and, furthermore, that in the lower forms of the Metazoa the whole animal, even when adult, can be profoundly modified by changes in its environment, whereas, as we pass up the animal kingdom this effect of the environment becomes less and less and its place is taken by an internal regulating mechanism, existing in the living animal itself. If this be so, then

¹ Huxley, J. S., 1927. 'Further work on Heterogonic growth.' *Biol. Zentvalb.*, Vol. xlvii, p. 151.

² Shaw, M. E., 1929. 'A Contribution to the Study of relative growth of parts in *Inachus dorsellensis*.' *British Journ. Exper. Biol.*, Vol. xi, p. 145.

³ Tazelaar, M. A., 1930. 'The relative growth of parts in *Palæmon carcinus*.' *British Journ. Exper. Biol.*, Vol. vii, p. 165.

⁴ Kunkel and Robertson, 1928. 'Contribution to the Study of Relative Growth in *Gammarus chevreuxi*.' *Journ. Mar. Biol. Station, Plymouth*, Vol. xv, p. 655.

by altering these external conditions we should be able to produce changes in the development and structure of the lower animals and but little, if any, in the higher. Numerous methods of affecting such alteration will doubtless occur to many of you; during the past years an enormous number of such experiments have been carried out and in the time that is left at my disposal I can mention only a few. I have, therefore, for the most part confined my attention to those experiments in which such changes of environment have been utilized as might reasonably be supposed to have occurred in nature, or those similar to such changes. The various functions of protoplasm, as all will admit, are brought about by, or at any rate are accompanied by changes in the constituent atoms and molecules. It has been thoroughly well established that the characters of an animal are transmitted from parent to offspring by minute particles, known as 'genes', that are connected together in the chromosomes of the nucleus, and two workers, Przibram¹ and Morgan² have independently put forward the view that these genes are individual molecules. Any alteration in the ionic movement in or the atomic composition of these protoplasmic molecules must presumably result in an alteration in the character or composition of the protoplasm itself and so of the animal as a whole. A nerve-impulse, travelling along a nerve, is accompanied by an electrical change that can be demonstrated and similarly a contracting muscle also gives an electric response, due apparently to a change in the physico-chemical condition of the protoplasm at the moment of contraction. By the activity of the protoplasm complex chemical substances are broken down into more simple substances and energy is set free; such a process is known as 'katabolism'. On the cessation of activity, or even during its continuance, simple substances are built up into complex bodies, a process known as 'anabolism', while other substances, the result of the breaking down of the energy-forming compound, that are unsuitable for the future use of the body, are got rid of by excretion; and corresponding changes must have been going on in all organisms, in whatever stage of development or evolution, since life first appeared on the earth. These activities, then, can be set in motion or varied by changes in the physico-chemical conditions surrounding the organism or cell and, like all chemical processes, can be slowed or accelerated by appropriate changes in the surroundings. Changes in the viscosity of the protoplasm of the non-cellular organism can be brought about by various salts, some producing liquefaction, others causing a gelation and solution,³ while the influence of certain chemical salts on the activity of the cells of the body is well known to all students of physiology. It is also well known that a rise of temperature accelerates chemical changes and the same holds good of living matter. In so-called

¹ Przibram, Hans, 1929. 'Quanta in Biology.' *Proc. Royal Soc. Edinburgh*, Vol. xlix, p. 224.

² Morgan, 1922. 'On the Mechanism of Heredity.' *Proc. Royal Soc. London*, Series B, Vol. xciv.

³ Brinley, Floyd John, 1928. 'The effect of chemicals on viscosity of protoplasm of *Amoeba* as indicated by Brownian movement.' *Protoplasma* Vol. iv, p. 177.

cold-blooded animals, in which the temperature of the body varies with that of the surroundings, a rise of temperature is accompanied by an increased velocity of movement¹ that is directly proportional. On the other hand, a lowering of the temperature causes a slowing of the frequency of the heart-beat in *Daphnia*.² If this lowering of the temperature is rapid there is a definite lag before the slowing of the heart-beat reaches equilibrium; and this lag possesses a time-factor that corresponds with and appears to be due to the increase in viscosity of protoplasm as a result of cooling. Again an alteration in temperature will considerably affect the rate of development, a higher temperature accelerating it and a lower causing retardation. The rate of division (fission) in *Paramecium* can be increased or retarded by corresponding changes in the temperature.³ In the case of the eggs of certain Insecta (Orthoptera), the difference in rate of development has been found to be strictly proportional within those limits of temperature at which it is possible.⁴ So dependent on the temperature is the rate of development that if one side of an egg only be heated, then development on that side will be more rapid than on the other and the embryo will become bilaterally asymmetrical. But the changes brought about by alteration in temperature may be much deeper seated than this and not only the rate but the whole character of the developing animal may be changed. Monstrous forms can be produced in a culture of *Paramecium caudatum*⁵ by reducing the temperature to 3°C. and then allowing it to rise again to the normal temperature of the room. Every student of Zoology knows that changes in the season may so affect the Water-flea, *Daphnia pulex*, that the female, which during the summer months has been producing parthenogenetic eggs that develop into females, will with the onset of autumn commence to produce thick-shelled eggs that develop into males and the same is true of other Cladocera. Probably, this is to some extent the result of a lowered temperature causing corresponding delay in development, somewhat similar to the results obtained by Hertwig, who has shown that delayed fertilization of frogs' eggs causes an increase in the number of males. Temperature changes, however, may in a similar manner even affect the animal after it has left the egg stage; Witschi⁶ has shown that the effect of extreme heat on tadpoles is to cause a change of sex from female to male.

¹ Przibram, Hans, 1909. 'Aufzucht, Farbwechsel, und Regeneration der Gottesanbeterinnen (Mantidae). III. Temperatur und Vererbungsversuche.' *Archiv für Entwicklungsmechanik*, Vol. xxviii, p. 561.

² Belehrádek, Jan., 1928. 'La ralentissement des réactions biologique par le froid est causé par une augmentation de la viscosité du protoplasm.' *Protoplasma*, Vol. lii, p. 317.

³ Mitchell, William H., 1929. 'The division rate of *Paramecium* in relation to temperature.' *Journ. Exper. Zool.*, Vol. liv, p. 383.

⁴ Bodine, J. H., 1925. 'Effect of Temperature on rate of Embryonic development of certain Orthoptera.' *Journ. Exper. Zool.*, Vol. xlii, p. 91.

⁵ de Garis, C. F., 1927. 'A genetic study of *Paramecium caudatum* in pure lines through an interval of experimentally produced monster formations.' *Journ. Exper. Zool.*, Vol. xlix, p. 133.

⁶ Witschi, 1928. 'Studies on sex-differentiation and sex-determination in Amphibians.' *Journ. Exper. Zool.*, Vol. lii, p. 267.

Normally, sex differentiation occurs in the 4th week or after 28 days; but in those tadpoles that had been exposed to a temperature of 32°C. for varying periods, there was not a single female, though in the control eggs Witschi obtained 26 of each sex. In those treated with heat he found that 53 showed changes towards the male condition and 62 were typical males. There can be no doubt that the effect of the exposure was to so alter the genital organs that they changed from female to male.

Goldschmidt has found that a temperature of 37°C. is able to produce deep-seated effects on fruit flies and, finally, Plunkett¹ has shown that an increase in temperature causes a change in certain characters in *Drosophila melanogaster*, one result, among others, being the diminution in the numbers of hairs on the segments of the body.

Mere alteration in the normal conditions of light and darkness may set up deep-seated changes in the animal. As an example I may cite the effect of absence of light on the Aphidæ. In continuous light wingless Aphids produce, almost exclusively, wingless offspring. If, however, the exposure to light be reduced, then winged offspring will commence to appear; the most effective proportion of light and darkness in the production of winged forms is 8 hours' sunlight to 16 hours' darkness and the effect on the character of the offspring makes its appearance in two days. If, however, darkness be combined with starvation, the effect is even more marked and the production of winged forms begins after only 16 hours.² It has recently been claimed that changes in the amount of nutrition may of itself affect the ultimate sex of the 'Flour beetle' *Trebolium confusum* Duval.³ The sex-ratio is in this case not a simple relation of the nutritional condition, for slight starvation of the larvæ (i.e., 1 day) causes an increase in males and more prolonged starvation an increase in females. The author suggests that a certain number of specimens of either sex may have the sex changed to that of the opposite and that this is brought about by the biochemical and biophysical state of the body fluids acting on the germ cells. These effects, I would point out, however they be produced, are not on the animal itself, but on the germ-cells within the body of the animal, the effects being thus only visible in the next generation. A condition of semi-starvation may, however, produce changes in the individual if applied early enough. In the case of *Drosophila melanogaster*, Plunkett⁴ has shown that, if applied in the early stages of life, it may cause the production of forms with a marked decrease in the number of hairs on the body, while Casteal⁵

¹ Plunkett, Charles R., 1927. 'The Interaction of genetic and environmental factors in Development.' *Journ. Exper. Zool.*, Vol. xlv, p. 181.

² Shull, Franklin A., 1928. 'Duration of light and the wings of the Aphid *Macrosiphum solarifolii*.' *Zeitschrift Wiss. Biol.* (Abt. D.) Roux. Arch. Entwicklungsmech. Organ, Vol. cxiii.

³ Holdaway, F. G., 1930. 'Nutritional Status and sex determination.' *Nature*, p. 131.

⁴ Plunkett, Charles R., 1927. 'The interaction of Genetic and Environmental factors in Development.' *Journ. Exper. Zool.*, Vol. xlv, p. 181.

⁵ Casteal, Dana B., 1929. 'Histology of the eyes of X-rayed *Drosophila*.' *Journ. Exper. Zool.*, Vol. liii, p. 373.

by exposing embryos and larvæ has produced changes in the pigmentation of the eyes: but both these effects are comparatively, trivial and, indeed, may almost be termed pathological.

In certain of the insects, such as the bees, it is now recognized that we get in nature a variety of forms, the production of which appears to be due to differences in feeding in the early larval stage, and it has been proved that the addition of a substance such as Manganese salts to the food of one of the Butterflies will result in the production of a melanotic mutation that breeds true.

In the case of Rotifers, Tinesinger has shown that when the female parent was subjected to traces of alcohol, there was a marked shortening of life and a reduction in the number of eggs that were laid; and this latter character is transmitted to the offspring for two generations and then disappears. A similar result was obtained by Noyes.¹ Stockard² has got results of the same nature in a mammal, while Chaudhuri³ has shown that injection of alcohol into the male parent mouse very considerably alters the sex-ratio in the offspring, the number of male offspring being increased; in birds, however, Pearl⁴ only obtained a reduced fertility in the egg, and those which were fertilized gave rise to perfectly normal offspring. Whitney⁵ has found in Rotifers that whereas a scanty diet produces in the second generation only females, a copious diet causes the appearance in the second generation of 95 per cent males, thus showing that there is, as a result, a change in the eggs from which the daughters develop and that this change affects the grandchildren. A similar result has been obtained by Shull in his studies of the effect of external conditions, such as a manure solution, on the sex-determination of the offspring; he found that whether a female is to be a male producer or a female producer, is irrevocably decided in the growth period of the parthenogenetic egg from which that female hatches, that is, before this egg is actually laid, the effect of the external condition thus being on the *grandparent*.

If variation in the amount of sunlight or the amount or quality of the food-supply can produce such effects, one would expect to find that such agencies as ultra-violet radiation, radium-rays, and X-rays were even more efficient, and such is undoubtedly the case. Taking first the effect of ultra-violet radiation on the noncellular Protozoa, it has been found that exposure to such rays for periods as short as from two seconds to two minutes, either every day or on alternate days, is sufficient to produce well-marked results

¹ Noyes, Bessil, 1922. 'Experimental studies on the life history of a Rotifer reproducing parthenogenetically.' *Journ. Exper. Zool.*, Vol. xxxv, p. 225.

² Stockard, Charles R., 1918. 'Further studies on the modification of germ cells in mammals; the effect of alcohol on treated guinea pigs and their descendants.' *Journ. Exper. Zool.*, Vol. xxvi, p. 119.

³ Chaudhuri, A. C., 1928. 'The effect of the injection of alcohol into the male mouse upon the secondary sex ratio among the offspring.' *Brit. Journ. Exper. Biol.*, Vol. v, p. 185.

⁴ Pearl, Raymond, 1917. 'The experimental modification of germ cells' I, II, and III. *Journ. Exper. Zool.*, Vol. xxii, pp. 125, 165 and 241.

⁵ Whitney, D. D., 1907. 'Determination of sex in *Hydatina senta*.' *Journ. Exper. Zool.*, Vol. v, p. 1.

in a culture of *Chilodon uncinatus*,¹ a holotrichous ciliate of the family Chlamydodontidae; a number of modifications were produced among which were (1) a race that closely resembled a different species, *Chilodon cucullus*, and this modification continued for generation after generation for months and even persisted after encystment and (2) the production of a tailed form that bred true for 48 generations; other changes were the production of fused individuals or twins, similar to those that I have already mentioned (*vide supra*, pp. 4, 14). The effects produced may be summarized into the following groups:—

- (1) Mutations that continue after encystment and conjugation.
- (2) Modifications that persist for some time and bred true, but die out with encystment or conjugation.
- (3) Temporary variations which disappear after 3 generations, and
- (4) Abnormalities that cause death.

It has been found in practice that the effects of these types of radiation on developing higher animals are not produced uniformly but that there is a much more marked effect in certain regions of the animal body than in others, the effect apparently depending on the activity of the part. The work of Hyman and Bellamy² has shown that the various organs of a body are not all equally active; thus in sponges the region round the osculum, or the exhalant aperture, is more active than the rest of the body; in Hydroids the tips of the tentacles are more active than the body and this latter more than the stem: in Medusæ the tips of the tentacles and the margin of the umbrella are most active, while in flat-worms the two ends are more active metabolically than the central part. In a developing animal there is a definite metabolic gradient; as a rule the head end is metabolically the most active, but this may, at any rate in part, be due to the complexity of this region for it has been found that the rate of metabolism is definitely related to the complex character of the organ, the more complex the greater the metabolic activity. Now the higher the metabolic gradient the more susceptible is the part to outside influences such as radiation or poisons.

Experiments on the developing hen's egg³ showed that if the rays were directed against the shell, no results were obtained, but if a window was made in the shell, so that the rays could pass through, then a number of changes took place, among which were the production of double monsters or the duplication of parts. One result obtained showed that whereas there is normally a definite polarity in the developing egg, certain parts giving rise to definite organs, the effect of radiation is to stop the development of certain organs and the growth takes on the characters of a neoplasm or

¹ MacDougal, Mary Stuart, 1929. 'Modifications in *Chilodon uncinatus* produced by ultra-violet radiation.' *Journ. Exper. Zool.*, Vol. liv, p. 95.

² Hyman and Bellamy, 1922. 'Studies on the correlation between metabolic gradients, electric gradients, and galvanotaxis.' *Biol. Bull.*, Vol. xliii, No. 5.

³ Hinrichs, Marie A., 1927. 'Modification of development on the basis of differential susceptibility to radiation.' *Journ. Exper. Zool.*, Vol. xlvii, p. 302.

tumour. The parts most affected are those that have been shown¹ to possess the greatest metabolic activity, such as the developing Primitive streak, the special sense organs, limb buds, and those regions where foldings or flexures are about to take place.

The effects of radium rays or X-rays are very similar to those of ultra-violet radiation, but in the majority of instances the effects produced are pathological in character; Müller has dealt with the effects of radium and X-rays and Babcock and Collins have studied the effects of emanations from radio-active rocks on fruit-flies.

There is thus ample evidence that it is possible to modify the processes going on in an animal by changes in either its external or internal environment. But in nearly all these cases that we have been considering it is found that in the higher animals, changes in the environment, if applied to the adult, produce as a rule little or no direct modification and where any effect is produced, the result lies in the direction of pathological or even lethal changes. Environmental changes, if applied to the early larval stages or to the egg itself, may be effective, though here again in the highest forms the result is usually pathological. Changes applied to the adult, may, however, affect the offspring, though not the parent. In such cases the effect of the altered environment is to produce in the egg only a comparatively slight structural change; yet sufficient to affect the actual constitution of the molecules of the chromosomes of the nucleus and, if this can be done without causing the death of the organism or a loss of the power of reproduction, the result is to produce something new and, if this change be transmitted to the progeny, then the result is the production of a new species.

To sum up all the evidence that I have put before you, it would appear that throughout the whole evolution of the animal kingdom, with the attainment of each higher stage there has been a loss of some power or function. The change from a non-cellular stage to that of a multicellular organism caused the loss of at least one function, namely, that of continuous reproduction, in all cells except those of the genital organs. Later on, the actual shape of the organism becomes more and more fixed and less and less susceptible to external changes, and development has to proceed along definite lines, a head forming at one end and a tail at the other, regardless of the position of the developing egg; and all that can be achieved in the way of changes in the genital organs or the genital cells themselves, which still retain, in some degree and possibly to a considerable extent, the susceptibility to changes of environment that existed in the lower organisms in times past, is the production of comparatively insignificant variations in the more or less superficial characters or else changes of a pathological nature. There has thus been a gradual loss of plasticity. The lines along

¹ Hyman, Libbie H., 1927. 'The Metabolic Gradients of Vertebrate Embryos.' III. 'The Chick.' *Biol. Bull.*, Vol. lii, No. 1.

(This paper includes a large number of references to the work of previous authors on the effects of abnormal conditions, such as X-rays, exposure to electric current, action of chemical vapours, e.g., alcohol, ammonia, ether, lack of oxygen, delayed incubation, and high or low temperatures, on the normal process of development.)

which an animal must normally develop, become more and more fixed and conversely the degree to which it can be affected gradually becomes less and less as we pass up the scale, while the period of existence in which an animal can be influenced is more and more limited and this limit is reached at a progressively earlier stage in its development. It would thus seem that, after all, the physicist may be right and that in the higher forms of life, including ourselves, we may be rapidly approaching the stage when further evolution is becoming impossible. If that be the case, then we are equally rapidly approaching the stage when, unless we have become completely superior to our environment and can ignore any and all changes in our external conditions, the existing higher animals and especially the human race will disappear from off the face of the earth to make way for some other form of life that has not as yet become restricted in its power of response.

(To be continued.)

A SPIDER THAT CAN CHANGE THE COLOUR OF ITS EYES
AT WILL.

(*MYRMARACHNE PLATALEOIDES*, CAMB.)

BY

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(With 4 plates and 4 text-figures.)

INTRODUCTION

The following article is one of a series of studies I have been making regarding some of the local ant-mimicking spiders. In sending out these notes I have to acknowledge very gratefully the great help and encouragement extended to me by the Hon. Secretary, Bombay Natural History Society, and by the Director of the Zoological Survey of India, by advice regarding identifications, literature, etc. I also gratefully acknowledge the help given me by Dr. F. H. Gravely of the Madras Museum who first drew my attention to this interesting side of Spider life, and by my professor at the Presidency College, Madras, Rao Bahadur K. Ramunni Menon, under whom I learnt the pleasures of open air zoological study. To many others also I am deeply indebted: to Dr. Warburton, S. Kensington, who so kindly responded to certain queries of mine and gave me some valuable suggestions, to Miss E. C. Carrapiett, the lady Principal of this institution, who in many ways helped and encouraged me in this work, and to Mr. James Pryde, the Principal and Professor of Natural Science in the local Science College, who so kindly permitted me to use certain instruments in his laboratory.

Under the heading 'On the change of Colour in the eyes of an Attid Spider' a note was published in *Nature*, vol. 68, 1908, by Mr. T. Padmanabha Pillay, Trivandrum. He observed a small Attid Spider which could change the colour of its eye at will. Since then no further contribution on this peculiar phenomenon seems to have been made. In the following notes the present writer gives an account of his observation and studies on the eye peculiarity as seen in the spider *Myrmarachne plataleoides* from Travancore.

In the description of *M. plataleoides* by Peckham in the Occasional Papers of the Natural History Society of Wisconsin, 1889, where specimens from Ceylon are described, the eyes are all referred to

as black. While this would be quite true to a casual observation of dead specimens, scrutiny of living ones shows that the case is not quite so. This was noticed while examining a number of these spiders which were kept in captivity. In a living individual the large anterior median eyes appear sometimes quite transparent or pearl-coloured and at other times quite black. The other eyes of this spider are all quite black. If these anterior median eyes are closely looked at for a few seconds the observer will be struck by a change in their apparent colour. These eyes change from dull whitish to black and from black to dull whitish. This change may be brought about rapidly or slowly. Sometimes both the eyes change colour alike; sometimes only one with the result that one eye is black and the other white at the same time. See fig. 8, plate III.

What can be the meaning of this white colouration for these eyes? Simon has suggested that the white eyes are for use at night and that the black ones may be diurnal. This, in this spider at any rate, cannot hold true for these spiders do not seem to be nocturnal at all. For the night they weave tiny silken retreats in which they rest. Even when disturbed they are very shy and quite unwilling to move about, which, were they nocturnal, they would not be.

A number of times, specimens of *M. platyleoides* have been observed at night in their retreats: they do not recognize the intruder's approach—in the day time it is almost impossible to avoid their noticing the intruder. On taking a needle to the front of the spider, and even on flourishing it in front of its eyes, it remains unaffected. Only on touching it with the needle does it 'awake' and run about wildly.

A specimen was kept in a small cage and occasionally fed on tiny insects. One night, after the spider had retreated into its nest, a small insect was introduced into the cage to see if the spider would attack it during the night, which could be expected if it were nocturnal. But the next morning the insect was found alive and the spider still at rest. An hour or so later the spider got out and was seen holding the insect in its jaws!

These and other observations of a like nature show conclusively that these spiders are not nocturnal at all. For an animal that is quite diurnal, to have the most important eyes, situated in the position of maximum efficiency and utility, adapted for vision at night seems quite unintelligent.

Observation of these spiders as they move about among the tree branches and leaves convinces one that their power of sight is quite keen. The slightest movement of anything in front, even at a distance of two or three feet, seems to arrest their attention. They immediately stop in their path and scrutinize. Often from the edge of a leaf or side of a twig, they can be seen watching the intruder with the forepart of their body raised high, to command a wider view. Under all such circumstances it will be seen that it is these frontal eyes that are always directed straight at the object looked at. And if one looks closely into these anterior eyes one will be able to observe the curious change in their colour which has been already referred to.

What does this change mean? Can it be that this spider converts its eyes from diurnal to nocturnal and nocturnal to diurnal at pleasure? But then, why this brisk transformation in clear daylight?

The apparent iridescence of these eyes when they 'show white' reminds one of the phenomenon of 'shining of the eyes', so marked in the eyes of certain animals; (e.g. the cat). In such eyes, inside the choroid there is a layer—the *tapetum lucidum*—which reflects the rays of light that fall on it and thus bring about the iridescent gleam. In the spider *M. platyleoides* however, this phenomenon does not appear to be brought about in this way.

As one observes the change of colour in the eyes of this spider one is reminded of the phenomenon of the movement of pigment in the compound eyes of the crustaceans in adjustment to the intensity of light. There it is observed that in bright light the pigment completely invests each ommatidium thus isolating it from its neighbours, while, in darkness these pigment blinds are withdrawn. No such movement of pigments however can be observed in this spider.

Examination of the top of the cephalothorax as the eyes are being 'rolled' as it were, by the spider shows two small black streaks, at a little distance behind the eyes; moving to and fro. The top of the cephalothorax in most specimens is opaque but occasionally a few specimens—probably recently moulted ones—are seen, in which this portion is quite translucent. In these, the black streaks in the front part of the cephalothorax behind the eyes can be very distinctly noticed, being moved to and fro when the eyes are changing colour. In fig. 1, pl. I is shown the cephalic part of the spider, as seen from the dorsal side under a lens: the black streaks that are moved to and fro when the apparent colour of the eyes change, are seen distinctly. Recently hatched young of these spiders were also examined: in them the cephalothorax was quite translucent and movements of the black streaks were noted very clearly. See fig. 2, plate I.

It was evident that these moving streaks inside the cephalothorax had something to do with the observed change in the colour of the eyes. On removing the cephalothoracic shield carefully, one finds inside two elongated cone-like structures attached to the anterior median eyes. [Vide figs. 3 (plate I) and 4 and 5, plate II.] The hinder halves of these 'cones' are black or deep blue, while in front they are white or translucent. These 'cones' are movable inside the cephalothorax, the broad end being fixed. The black streaks that are seen moving to and fro as the colour of the eye changes from white to black or *vice versa*, are really the hinder halves of these delicate cone-like structures, seen through the translucent cephalothoracic shield. Evidently then, these spiders can move these 'cones' inside the cephalothorax: and as the 'cones' are thus moved, the black or the translucent portion of the 'cone' may be brought in the line of sight of the observer, thus making the eyes appear black or white as the case may be. The accompanying diagrams explain the mode of working of these eyes. The first diagram shows a 'cone' not waved to a side but held straight behind. In this position, an observer who looks from the front straight into

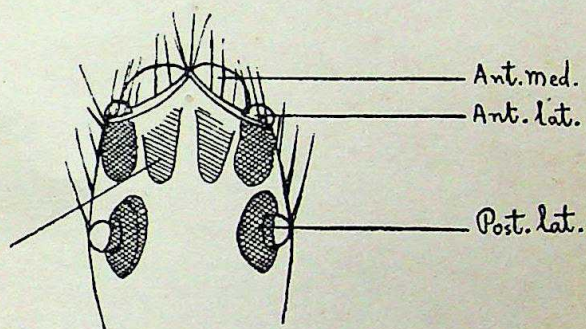
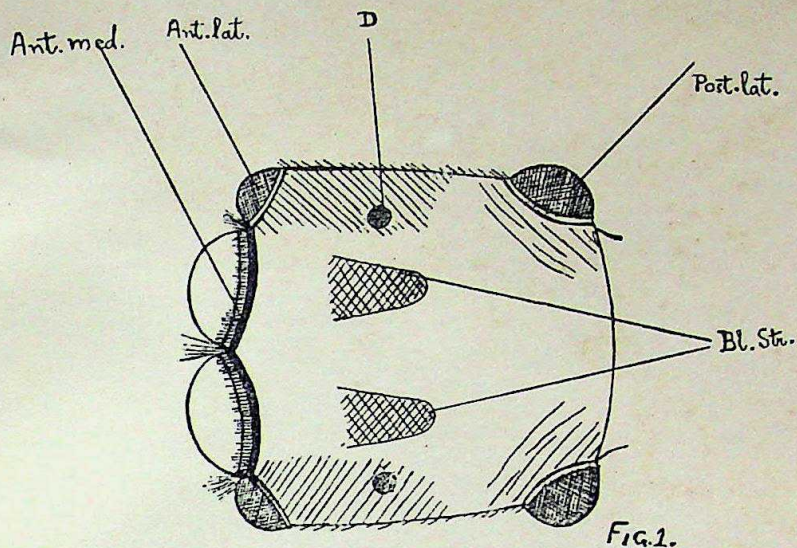


FIG. 2.

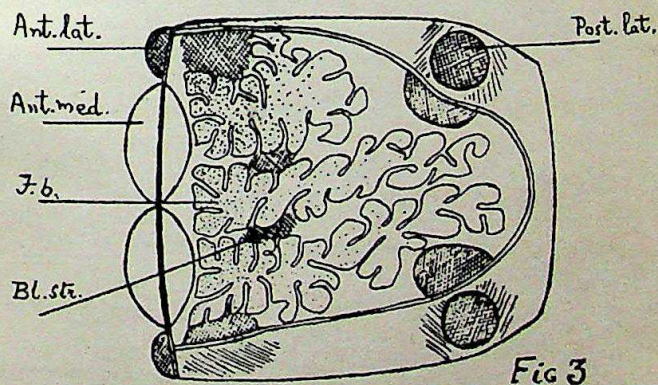
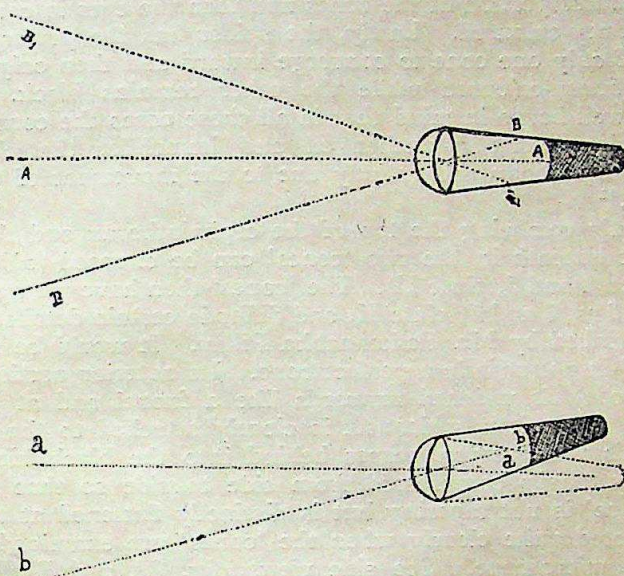


FIG 3

Change of Colour in the Eyes of the Spider *M. platyleoides*.
(For Explanation of plate see end of article).

the eyes, so that the line of sight is at right angles to the plane of the lens, will look into the depths of the 'cones' where they are jet black. He would see the eyes black (AA). If he



TEXT FIG. 1.

Diagram to show the action of the 'cones'. For description see text.

shifted his position considerably to a side, his line of sight would strike, out at the black region of the 'cone' but only its anterior translucent portion: in consequence the eyes would appear whitish (BB and B' B').

The second diagram represents the 'cone' as it is waved inwards. In this position an observer from the front looking in such a way that the line of sight from his eyes strikes the lens at right angles to its plane, would be looking, not into the black part of the 'cone', but at the translucent anterior region and hence he would see the eye whitish (aa). If he shifts his position outwards to a certain extent, he would be looking into the depths of the 'cones' and thus the eyes would appear black (bb).

From what has been explained above it will be clear that when an observer looks at the eyes from the front, they appear white or black according as the 'cones' are waved or not: and that the apparent colour of the eye at any particular time depends on the position of the cones and also on the position of the observer.

The spider on which Mr. Padmanabha Pillay made similar observations was not identified and the account he gives of its appearance, while it does not give us any clue towards its identity, makes it clear that it was not *M. plataleoides*. What he says about the change of colour of the eyes in this spider may, however, be quoted as it is essentially in agreement with what I have observed

in *M. plataleoides*. He says '... when the spectator faces the eyes and the axes of the cones are parallel he sees into the depths of the cones and the eyes necessarily appear jet black. When the two tips of the cones converge the line of sight strikes the honey-coloured outer portion of the cones and then the eyes in consequence appear honey-coloured. Lastly, the spider has the power to cause the tip of only one cone to converge inward and then only that eye appears honey-coloured while the other remains black.... It must be well borne in mind that in all these cases the cornea of the eye remains perfectly unchanged and immobile, the change of colour being wholly and entirely due to the movement of the cones behind it.'¹

By gently removing the top of the cephalothorax and the tissues lying just beneath it, the two 'cones' can be exposed (*vide* figs. 3, plate I and 4 and 5, plate II). The 'cones' then have the appearance shown in figs. 6 and 7, plate II, and differ in certain details from the cones described by Mr. Padmanabha Pillay. It would be seen that the 'cone' is not strictly a perfect cone. Its anterior portion, which is translucent, is widened forwards like a funnel and at the front extremity where it is widest, it is closely attached to the cuticular lens. This wide region passes behind into the black hinder part which is strongly compressed from side to side so that the apex of the 'cone' is not tapering but is distinctly flattened at the sides. This is noted quite clearly when the 'cones' are examined under a dissecting microscope. See side views, fig. 7A and B (Plate II).

Transverse sections of the 'cones' at different parts of its length are shown in figs. 10 and 11, plate IV; the section through the anterior region (fig. 10) is more or less circular while the section through the hinder region (fig. 11) is elliptical due to the lateral compression of this region. The translucent anterior region on closer examination is found to be not quite translucent uniformly all over but to have slight pigmentation dorsally—in some specimens almost quite dark—while ventrally and on the sides it remains quite clear. This dorsal pigmentation of the anterior region of the 'cone' is of considerable interest. It in a very simple way explains why the eyes when looked at from below always appear black and from above always whitish. In Mr. Pillay's spider, this behaviour is slightly different and he accounts for it in another way. 'When the line of sight from the observer's eye to the cornea is at right angles to the latter the eyes invariably appear honey-coloured. The reason is obvious, namely, that the line of sight strikes only the honey-coloured portion of the conical sac behind the eyes. Hence it follows that the axes of the cones must be either above or below the line of sight. But as a matter of fact, it is above it. The proof of this is that if you look at the eyes a little from below they appear black whereas if you look at them from above they still remain honey-coloured. The accompanying diagram demonstrates that this can only be the case if the cones lie on an inclined plane with the apices a little above the plane which divides the cornea horizontally into two equal halves.'

¹ *Nature* 68, 1908.

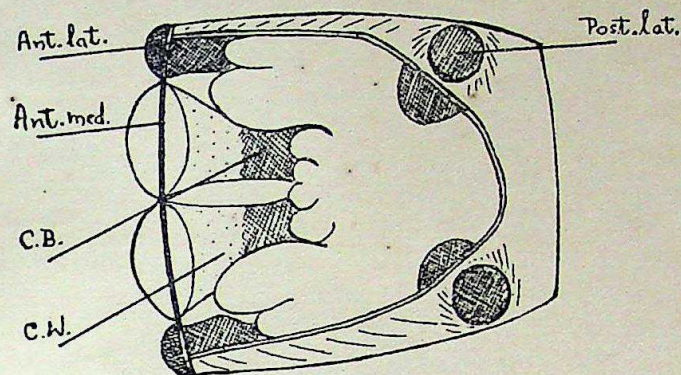


FIG. 4.

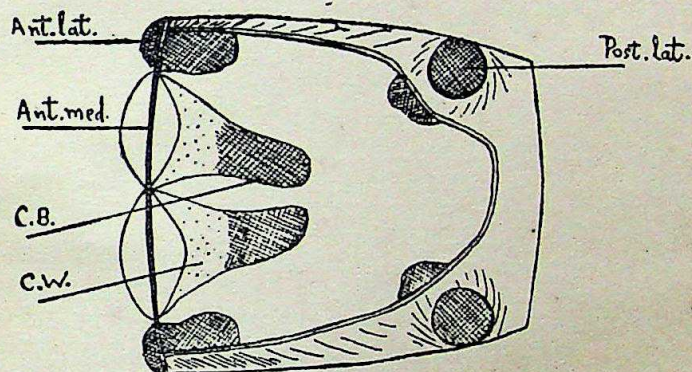


FIG. 5.

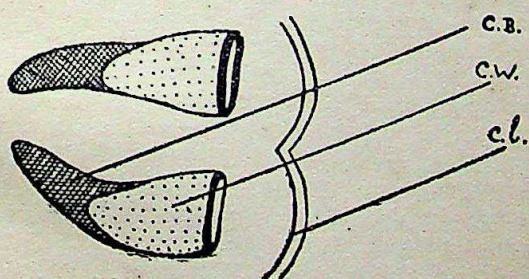


FIG. 6.

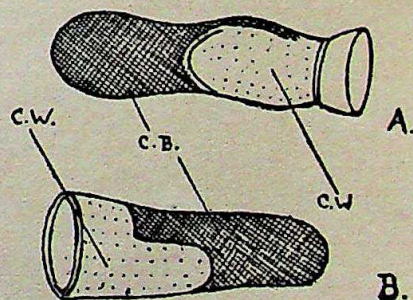


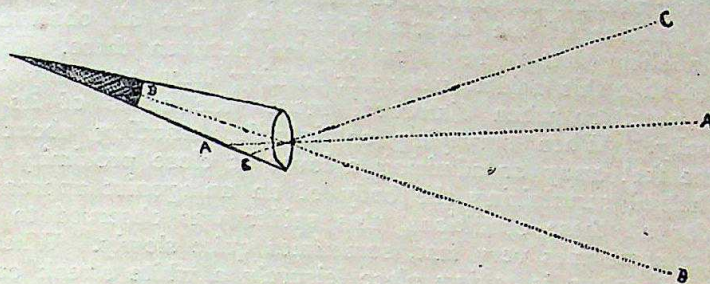
FIG. 7.

Change of Colour in the Eyes of the Spider *M. platycoides*.
(For Explanation of plate see end of article.)

CHANGE OF COLOUR IN SPIDER'S EYES

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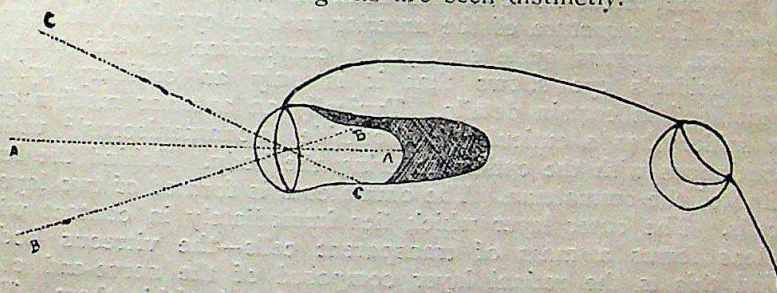
In *M. platyleoides*, however, the eyes, when looked at straight, horizontally from the front, i.e., 'when the line of sight from the observer's eye to the cornea is at right angles to the latter', show



TEXT FIG. 2.

Diagram given in *Nature* 68, 1908, by Mr. Padmanabha Pillay. For explanation see the above quotation.

the characteristic change in colour from black to white and from white to black. Hence it will be obvious that here the 'cone' is not displaced above the horizontal plane as in the other spider. Even if a slight displacement existed it would not in this case produce the same effect, as the 'cone' here has the apex not tapering but elongated dorso-ventrally. Actual dissection of these 'cones' fails to show any appreciable displacement of these above the horizontal plane such as would make the eye appear white when looked at from the front. This would be evident from the diagram given below and also from fig. 9, plate IV, which represents a longitudinal section through the cephalothorax cutting parallel to the long axis of the anterior median eyes. The section is not de-pigmented so that the dark and clear regions are seen distinctly.



TEXT FIG. 3.

As there is no upward displacement of the free end of the 'cone' an observer looking at these eyes straight from the front look into the depths of the 'cones' (see diagram above) when these are not moved inwards, and so the eyes appear black (AA). If the 'cones' are converged the line of sight strikes the translucent outer portion of the 'cone' and hence the eyes appear white. But when looked at from below the eyes invariably appear dark. This clearly is due to the dorsal pigmentation of the anterior part of the 'cone': for in this position the line of sight (BB) would strike at this darkened region of the 'cone'. When looked

at from above it appears white, for here the line of sight strikes the clear under-part of the 'cone' only (CC).

According to a suggestion of Dr. Warburton an attempt was made to discover whether this change of colour of the eyes had any relation to the distance of the objects looked at. But all observations seem to show that there is no relation between these. It was observed that this spider, whenever looking intently at any object far or near, or when disturbed, moves the cones of its eyes continually. When surveying an intruder standing about two or three feet away or admiring a lover at close proximity or in fierce hatred scrutinizing the body of an antagonist approaching it, under all these conditions, this spider was observed to 'roll' its eyes, sometimes very fast, sometimes quite slowly. When the change of colour is taking place leisurely a white streak can be observed traversing the cornea as the colour passes from one to the other. This certainly must be due to a narrow pale band that encircles the 'cone' in the region where it passes from the translucent to the dark.

A few stages in the gradual change of the colour of the eye, as one observes it from the front, are shown in fig. 8, plate III. On the left hand side a frontal view of the anterior median eyes is shown while on the right side the probable position taken by the 'cones' is indicated. A study of these diagrams shows clearly what happens in the anterior median eyes of these spiders. Figures A—E indicate that the movement of the 'cones' is mainly convergent i.e., the tips are brought together in the median line and then separated again. But the remaining diagrams seem to show that the movement is not so simple. Figs. F—G show that the 'cones' can be diverged to a certain extent while the last two figures suggest that there may be a slight twisting movement also. This last movement however has been observed only very rarely.

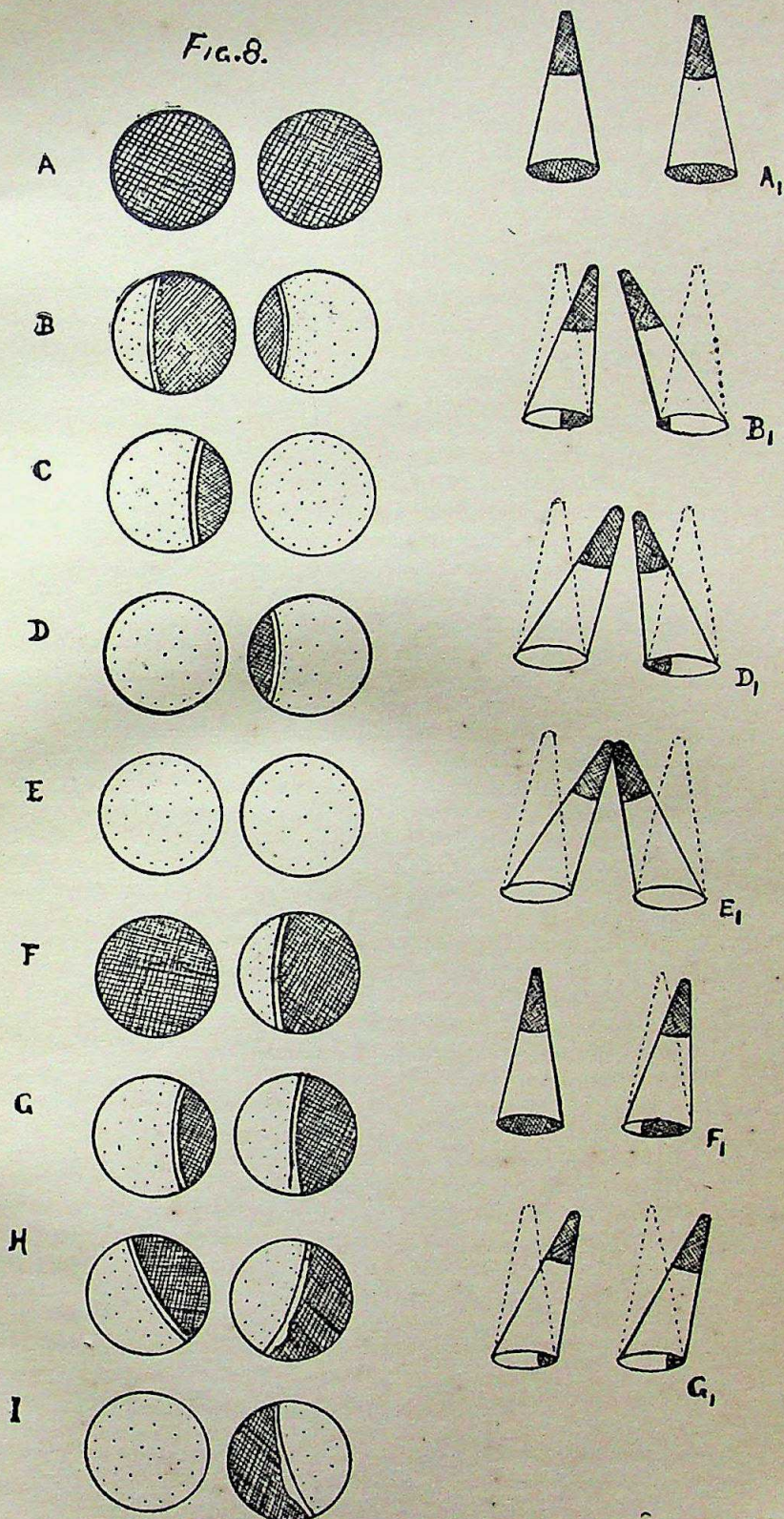
Though the structure of the anterior median eye with its 'cone' mechanism, appears quite strange, a comparison of this with a typical spider's eye shows that it is only an ordinary spider eye modified in certain details. Typically an anterior median eye of a spider¹ has a cuticular lens outside (monomniscous)² which is continuous with the cuticle covering the body. Behind the lens is situated the ommateum. The ommateum is formed of two layers of cells. The outer layer which lies immediately in contact with the lens forms a mass of transparent cells—the vitreous body. Behind this is the retinal layer composed of the nerve-end cells having considerable pigment granules developed within them. The spider-eye (at least the anterior median) seems to be 'auto-chromic' i.e., there is no intrusive connective tissue bearing the pigment but it is all developed in the nerve-end cells themselves.

A glance at fig. 9, plate IV, will show that the plan of structure of the anterior median eyes in *M. plataleoides* is essentially the

¹ In details of structure there are certain marked differences between the anterior median eyes and the other eyes of spiders.

² 'Unicorneal' of some authors but as Lankester and Bourne have shown 'monomniscous' is a better term. Vide *Q.J.M.S.*, Vol. xxiii, 1883.

Fig. 8.

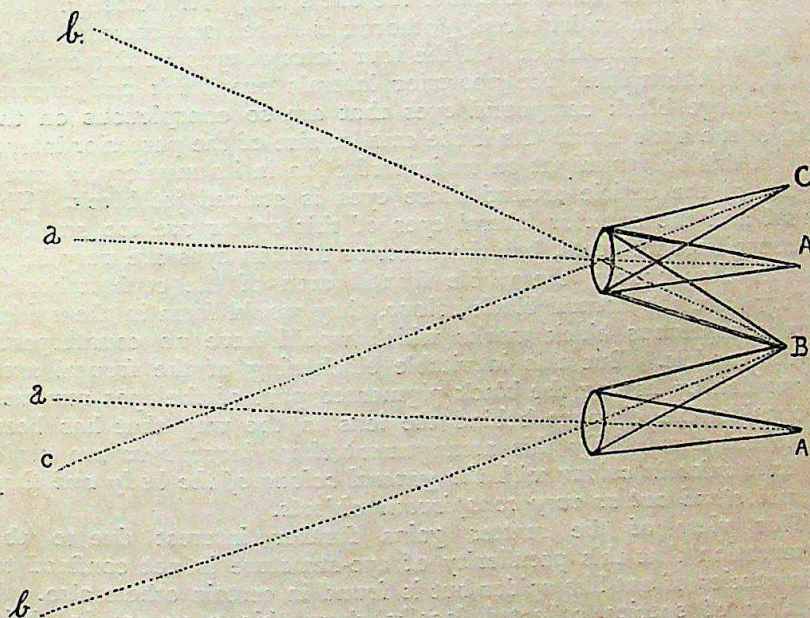


Change of Colour in the Eyes of the Spider *M. platyleoides*.

(For Explanation of plate see end of article.)

same.¹ The chitinous cuticle is thickened, forming the lens. Behind this are the clear enlarged hypodermis cells form the vitreous body. This however instead of forming a closed cup, as is usually the case, becomes elongated constituting the anterior translucent part of the 'cone'. The 'cone' in fact is only the ommateum which is unusually elongated and made mobile. The pigmented region formed of the retinal cells instead of forming a layer closely investing the vitreous body, gets elongated and withdrawn considerably backwards constituting the distal region of the cone-like structure extending behind the lens.

As the pigmented region is formed of the retina or the nerve-end cells, it is evident that the sensitive part of the eye is confined to the hinder black part of the 'cone' or ommateum. Hence, when the 'cone' is moved the spider is actually bringing the sensitive part of the eye in line with the different parts of the field of vision, thus getting clearer view of them. The diagram below demonstrates this:—



TEXT FIG. 4.

In the position AA, i.e., when the 'cones' are not moved, the spider will be seeing very clearly objects straight in front (aa) as images of these would be directly falling on the retina. By converging the 'cones' the range of vision can be considerably increased.

¹ No attempt is made in this article to describe the minute structure of the eye. As the purpose of this paper is to investigate the observed change of colour of the eyes and as this phenomenon is dependent on the distribution of the pigment in the ommateum, the sections sketched are not completely depigmented. However, a study of the anatomy of these eyes of this spider and of others which show this same phenomenon would be quite interesting. It is hoped that this may be undertaken in another paper.

Thus in the position B, the field of distinct vision becomes much wider (bb), and the spider by moving the 'cones' to different extents may concentrate its attention on any particular part of this wide field.

Thus, by moving the 'cones' the spider can command a wider field of view. This particular phenomenon would then functionally correspond to the rolling of the eyeball by the muscles attached to it in the vertebrates and to the movements of the stalked eyes in some of the arthropods. But, while in the former the eye ball is moved and in the latter, the entire eye as a whole, in this spider the lens remains fixed and immobile while it is the ommatidium that is moved directing the sensitive surface, the retina, at different angles.

Another probable significance of this phenomenon might be suggested. *M. plataleoides* is a perfect mimic of the Red Ant (*Ecophylla smaragdina*), in close company with whose colonies these are met with. The body of the spider is elongated and constricted in such a manner as to resemble the ant's body very closely. The front part of the spider's cephalothorax is raised and rounded so as to suggest the ant's head. Of the four pairs of eyes on this cephalic region of the spider, the posterior laterals are black and answer to the large black compound eyes that are so conspicuous on the sides of the ant's head. As if the smaller size of the posterior lateral eyes in this spider might be an imperfection in its mimicry, a small region of the cuticle around these eyes is stained jet black. The dorsal and the anterior lateral eyes of this spider are too small to be conspicuous objects, but the anterior median eyes are very large and as they occupy the whole frontal area of the cephalothorax, if they have the normal black colour, they would form in the spider very conspicuous black marks which would have no counterparts in the models. But this inevitable blackening of the frontal area is avoided by having the black pigmented part of the eyes removed a considerable distance behind the lens in the way that has been explained above. By this arrangement *these large eyes are made to harmonize in colour with the general colour of the body and they do not stand out as very conspicuous objects.*

This view of the matter gains further interest due to the observation that this peculiarity of eye-structure is not confined to this species of ant-like spider but is found in certain others also. A number of species collected locally show this structure in their anterior median eyes, though the actual change of colour has not been observed in all of them. A dark brown and another quite black species, however, have been observed performing this curious feat. This is interesting. In the latter species the spider is black and the eyes too looked all black. After a few hours' patient observation it was obvious that this spider also 'rolled' its eyes in the same way as did *M. plataleoides*: but with this difference—when the black part of the 'cone' is in the line of sight of the observer the eyes are deep black as in the other type: but, when the 'cone' is moved a little so that the line of sight of the observer meets the translucent portion of the 'cone' the eye appears not honey-coloured as in *M. plataleoides* but dark, only not so deep as before. In fact, detection of this phenomenon would have been

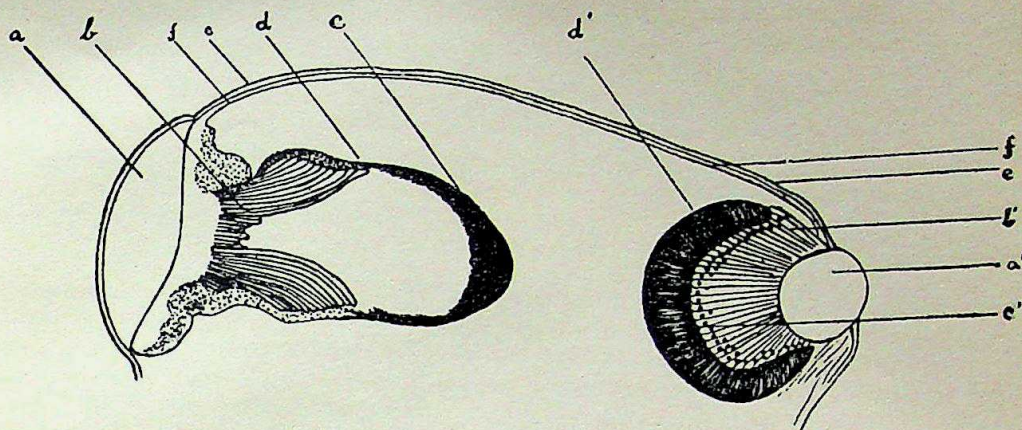


FIG 9.

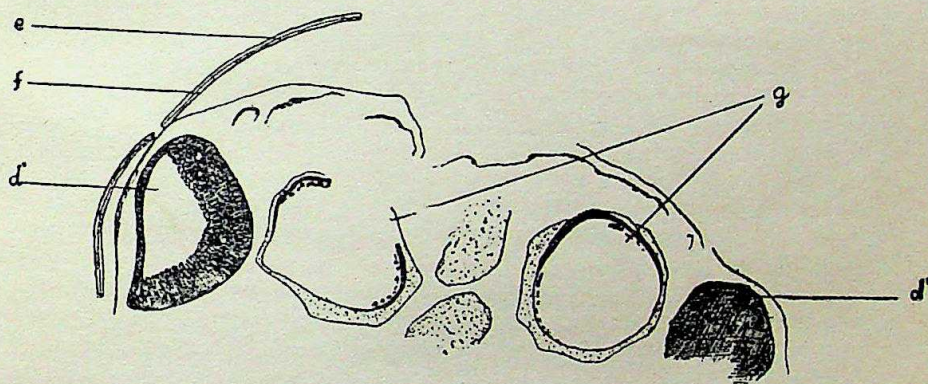


FIG 10.



FIG. 11.

Change of Colour in the Eyes of the Spider *M. plataleoides*.
(For Explanation of plate see end of article.)

very difficult here, as no appreciable change in colour is produced when the 'cones' are moved, but for the fact that as the 'cone' is moved to and fro a clear streak can be observed crossing the lens. It might appear a little strange that a completely black spider should be provided with this mechanism: the whole spider is black and where can be the necessity for withdrawing the black pigmented part of the eye to the hinder end of a 'cone'? And why should there be the elaborate mechanism for waving of the 'cones' when this fails to produce any appreciable alteration in the colour of the eyes? And if this change of colour is brought about, would it not be meaningless here?

Confronted by this problem I was first inclined to suppose that this might be the general plan of structure for the anterior median eyes in ant-like *Attidæ*. Whatever be the colour of the mimic, the translucent front portion of the 'cone' ensures the obscuring of the otherwise too conspicuous black frontal eyes by approximating the colour of these to the colour of the body. This apparently would be unnecessary in the dark species: but when we recollect that many of these are lighter coloured and that the depth of colour is highly variable among these, the value of this provision would be obvious.

While studying this phenomenon, however, I came across a few other types of Attid spiders which showed this same mechanism in their anterior median eyes. These spiders show no striking ant-like features and cannot be referred to as ant-mimics. One of these is yellowish with greenish legs and it seemed that probably this was the spider on which Mr. Padmanabha Pillay made his observations of this phenomenon. But we cannot be definite about this as the description he gives is quite insufficient. These spiders show the phenomenon of the change of colour of the eye to a remarkable degree, the 'cones' being very well developed. I hope to give an account of these spiders which possess this 'cone' mechanism in their anterior median eyes in a subsequent paper. Here, however, this observation is of considerable interest since it shows that this phenomenon is not restricted to ant-like *Attidæ* but is found in certain others also. Hence we cannot hold that this peculiarity of the anterior median eyes is special to the ant-like *Attidæ* and that it exists for the purpose of obscuring the frontal blackening that may be caused by these eyes. At the same time we can safely maintain—for it is a matter of observation—that where this type of eye exists the inevitable frontal blackening is obscured. The withdrawing of the pigmented part of the eye to the hinder end of the 'cone' is not specially for the purpose of obscuring the otherwise too conspicuous frontal eyes: but when this type of eye-structure exists it produces this effect which may be of advantage under certain conditions. Thus, this obscuring may be of no special benefit in the non-ant-like spiders while in some of the ant-like forms it may be of some distinct advantage as suggested above.

SUMMARY.

1. The anterior median eyes or the principal eyes of Attid spiders are generally black while in certain species they have been observed to be white. In some of these species, however, it has been found

that these eyes cannot be strictly described as either black or white. Their colour has been observed to be always changing from one to the other during life so that at one time they may appear black, but the next instant they become white and then again black and so on.

2. It does not seem likely that the white colour of these eyes indicates their being nocturnal. The habits of some of the species showing this feature as well as the nature of the phenomenon seem to exclude any such possibility.

3. It is also not likely that this change of colour of the eyes has any relation to the distance of the objects looked at or to the intensity of the light.

4. The white colour is not produced by any movements of pigments themselves, or through a reflecting tapetum, but is caused by an internal mechanism. This consists of the ommateum which is elongated, the anterior region formed entirely of the clear vitreous body while the nerve-end cells containing the pigment granules are arranged behind. This elongated ommateum is freely mobile at the distal-end and when the spider moves it to different positions the eye may appear white or black according as the white or the black region of the ommateum is in the line of sight of the observer.

5. This movement of the ommateum may be of considerable advantage to the spider inasmuch as it widens its field of vision and enables it to concentrate its attention on any particular object.

6. In some of the ant-mimicking forms like *M. plataleoides* which mimics the Indian Red Ant, this may serve a secondary part, viz., the obscuring of the black patches in front (which might be disadvantageous in its successful mimicry) that would be caused by these eyes.

Note.—Since sending the above account, I had been making some further observations on this peculiar property of the anterior median eyes of spiders. A few more specimens of *Attidæ* were examined which showed this phenomenon. In some it could be ascertained only with considerable difficulty. A few specimens of *Thomisidæ* were also examined. In two species examined, the phenomenon could be distinguished quite clearly. In *Amyciwa*, the small anterior median eyes had little 'cones' attached to them which were waved to and fro very briskly making these little eyes shine with a pearly lustre now and then, immediately returning to the dark colour. Thus this phenomenon appears to be not restricted to the *Attidæ*, but extending on to at least one more family.

EXPLANATION OF PLATES.

Plate I (Figs. 1-3)

Fig. 1. A dorsal view of the cephalic region of *M. plataleoides* showing the position of the eyes and the black streaks behind the anterior median eyes which are waved to and fro as the colour of the eyes change. Mag. about 40 times.

Fig. 2. A dorsal view of the cephalic region of a young *M. plataleoides*, recently hatched. The black streaks behind the anterior median eyes are clearly visible.

Fig. 3. Dissections of the cephalic region of *M. plataleoides* so as to show the 'cones' of the anterior median eyes. In Fig. 3, the cephalic shield is removed showing the underlying fat body between the ramifications of which the black streaks may be made out. Magnified about 40 times.

Ant. med.....Anterior median eyes.

Ant. lat.....Anterior lateral eyes.

Figs. 4 and 5. Dissection of the cephalic region of *M. plataleoides* so as to show the 'cones' of the anterior median eyes. In Fig. 4, the fat is removed and the 'cones' are partly exposed, partly covered over by the lobes of the brain. In Fig. 5, the brain also is removed thus exposing the two 'cones' completely. Magnified about 40 times.

Fig. 6. The 'cones' of the anterior median eyes as seen under the dissecting microscope after the removal of the cephalic shield and the tissues beneath.

Fig. 7. A & B. Side views of these 'cones'.

Fig. 8. The anterior median eyes of *M. plateleoides* as seen when looked at from the front. The series of diagrams on the left hand side show the appearance of the eye as the colour changes. On the right side the corresponding position taken up by the 'cones' is represented. For example, A₁ represents the position of the 'cones' when the eyes are seen black as at A, while F₁ shows the position assumed by the 'cones' when the eyes appear white as at F.

- Fig. 9. A longitudinal vertical section through the cephalic region showing one of the anterior median eyes and a posterior lateral eye in section. The section does not pass through the median line of the anterior median eye but slightly to a side. The diagram was drawn from one of my slides with the help of a camera lucida. [Magnification—110 diam.]

- Figs. 10 and 11. Transverse sections of the cephalic region passing through the 'cones' of the anterior median eyes. These diagrams were drawn from my slides with the help of a camera lucida. [Magnification $\times 110$.]

- Fig. 10. Section passing through the anterior region of the 'cone' which is clear and translucent.

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THE ROLE OF SUNBIRDS AND FLOWER-PECKERS IN
THE PROPAGATION AND DISTRIBUTION OF THE
TREE-PARASITE, *LORANTHUS LONGIFLORUS* DEST.,
IN THE KONKAN (W. INDIA)

BY

SALIM A. ALI.

(With 2 plates and 4 diagrams.)

Even the most casual observer of Nature cannot but notice the ubiquitous clumps of the tree-parasite (*Loranthus*) with yellowish-green, rather long, oval-shaped leaves which infest the trees in such profusion in Western India and elsewhere throughout the country. Once it has secured root-hold, the parasite spreads from branch to branch with astounding rapidity, and unless removed in time it is not long ere the host is sucked dry and smothered to death. I have had special opportunities for studying the subject of the role of birds in the propagation of the species *L. longiflorus* Dest. during the past year. My observations have brought me to the conclusion that the life-history of the parasite is so inextricably linked up with the existence of Sunbirds and Flower-peckers that it would soon die out altogether without the intervention of the birds. Indeed it seems to me that the only effective way of eradicating the parasite lies in the extermination of the Sunbird, a vandalism, it is to be hoped however, no one will seriously take into his head to practice. 'Man cannot live by bread alone,' and the Sunbird is surely one of those etceteras that help to supplement bread for the sustenance of man. This symbiosis has brought about the most remarkable specialization in the flowers of *L. longiflorus*, which is now without doubt one of our most highly developed 'Bird-flowers' in India. And what is true of *Loranthus longiflorus* is likewise true of many other Indian species as well.

Hosts of the *Loranthus*.—In Western India, *L. longiflorus* is a serious menace to the mango, and in the mango-growing districts of Ratnagiri and North Konkan the damage it causes must run to thousands of rupees annually. In smaller numbers I have also found it affecting the following trees: *Zizyphus* sp., *Bombax malabaricum*, *Psidium guava*, *Thespesia populnea*, *Grewia* sp., *Ficus bengalensis*, and *Casuarina equisetifolia*, while at Roha, in the Kolaba district I noticed it parasiting on the Teak trees (*Tectona grandis*) in the reserved forests.¹

¹ Fischer records *L. longiflorus* from hosts of no less than 104 different species. If those of its varieties are added, the total number of specific hosts given by him is 153. (C. E. C. Fischer, 'Loranthaceæ of Southern India and their Host Plants.'—*Records of the Botanical Survey of India*, Vol. XI, No. 1.

PLATE I.

JOURN. BOMBAY NAT. HIST. SOC.



Photos

Loranthus longiflorus Desr. in bloom.



A Sunbird (*Leptocoma zeylonica*) probing into *L. longiflorus* flowers for nectar.

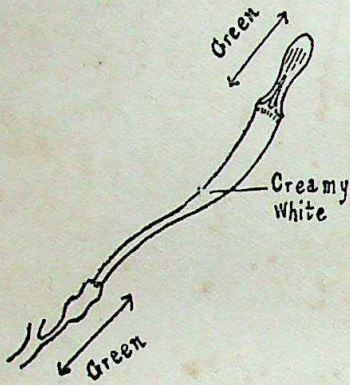


FIG. 1. Unopened Bud, *Loranthus longiflorus* Desr. Nat. Size.

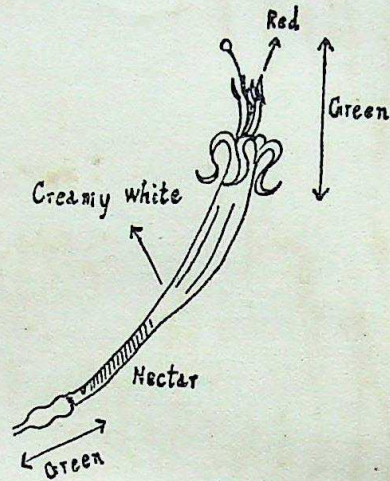


FIG. 2. Flower of *L. longiflorus*. Nat. Size.

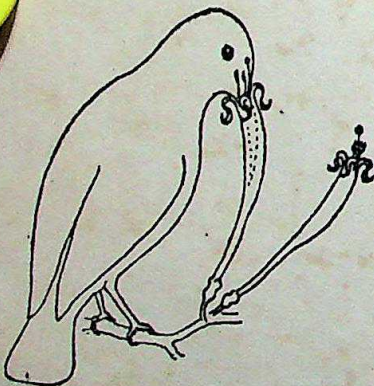


FIG. 3. Diagram of *Leptocoma zeylonica* feeding from *L. longiflorus* flowers. About $\frac{1}{2}$ Nat. Size.



FIG. 4. Seed of *L. longiflorus* With adhesive filaments *a* and *b*. Nat. Size.

Flowering Season and Structure of Flowers.—*Loranthus longiflorus* flowers in every month of the year, but the period from mid-November to about the middle of January seems to be that of most abundant inflorescence. Every clump of *Loranthus* is one mass of blossoms at this season. The flowers are white with a faint tinge of cream or sometimes pink. They are about 4 cm. in length, thin, tubular and slightly curved. Their shape and size form, in the upper part, a perfectly fitting sheath for the bill of the Sunbird. The lower portion of the flower, where the tube narrows down (shaded in Fig. 2) contains the nectar, one to two drops of a colourless, watery, sweet liquid. The stamens, five in number, rise from the petals and are overtopped by the style which is green and terminates in a tiny swollen knob—the stigma—about the size of a pin's head. The anthers are so arranged that when the bill of a Sunbird is inserted into the flower, they cannot but come into direct contact with the bird's forehead. The five stamens separate on the intrusion of the bill and the anthers lie flat against the feathers, encircling the forehead (Fig. 3). The pollen—a golden yellow dust—readily comes off to the touch and adheres to the feathers. The style, extending beyond the stamens, is naturally the first to come into contact with the forehead feathers, and if the Sunbird has been visiting other flowers previously, the pollen is brushed on to the mature stigma which is thus fertilized. The flowers of *L. longiflorus* belong to the ornithophilous type named by E. Werth¹ 'Explosionsblumen' or Explosive Flowers. How perfectly their mechanism is adapted for pollination exclusively by Sunbirds and Flower-peckers is seen from the fact that the buds will remain closed unless and until the necessary extraneous pressure is exerted to fling them open. The Sunbird hops from one bunch of blossoms to another, gently squeezing the tops of the mature buds (Fig. 1) in his mandibles. The pressure causes the bud to spring open or 'explode' exposing the essential organs (as seen in Fig. 2). The bird immediately thrusts its bill into the flower, sucks up the honey by means of its specially adapted, extensile, tubular tongue and passes on to a second bud. The extent of his services in fertilizing the flowers is immense. I have frequently observed one probing into 8 or 10 flowers in less than a minute, and when it is remembered that the bird spends the greater portion of the day in flitting incessantly from clump to clump in the self-same quest, some estimate can be formed of its importance to the *Loranthus*. Doubts have been entertained in regard to the object of birds' visits to flowers being solely for the sake of the nectar, and even to-day some ornithologists are inclined to assume that the search of insects is the primary cause. In the case of the *Loranthus* there can be no such uncertainty as the peculiar structure of the flowers precludes the possibility of the presence of insect prey within the tubes until the buds have first been visited and thrown open by Sunbirds or Flower-peckers. Besides, considering the high nutritive value of sugar, there seems no reason for doubting that some birds may, in a state of nature, exist exclusively

¹ E. Werth, 'Kurzer Überblick über die Gesamtfrage der Ornithophilie' Botanische Jahrbücher, 53, 1915.

on a diet of nectar. Sunbirds have been kept healthy in captivity for weeks together purely on a syrup of sugar and water,¹ and it is difficult to conceive that the 'short cuts' by birds to the honey in the flowers of *Sesbania grandiflora* as described by Tiwary² and of the many other species noted in Java by Porsch³ can be for any but this purpose. Birds may—and indeed often do—take in addition to the nectar, small insects if present on the flowers, but there can be no doubt that their visits to 'bird-flowers' are mainly in quest of the nectar. The numerous stomach examinations made by myself in the course of this enquiry, chiefly in the season of profuse flowering, on *Leptocoma lotenia*, *L. asiatica* and *L. zeylonica* confirm this.

Pollinating Agents.—In Western India (Konkan) the birds chiefly responsible for fertilizing *Loranthus* flowers are the Sunbirds, three of the commonest species being *Leptocoma lotenia*, *L. asiatica* and *L. zeylonica*, while occasionally Tickell's Flower-pecker (*Dicaeum erythrorhynchum*) who visits the clumps principally to feed on the ripening berries, will also lend a hand. I have shot specimens of the last named from flower clusters with the pollen adhering to their foreheads. Their stomachs contained much nectar which also dripped freely from the bill when the birds were held up by their legs.

To satisfy myself that the flowers were really incapable of developing without the interference of the bird visitors, I covered a bunch of 21 buds with 12 × 12 mesh wire gauze on 5th December. By the 19th, all the buds had withered and fallen off without a single one setting seed, though at one stage in the interval they were so mature that the red on the dorsal side of the anthers was partly visible through the slits near the top between the unopened, spring-like petals. Later the experiment was repeated on a larger bunch with the same result which shows that the agency of flower-birds is indispensable for fertilization in this species. Evans⁴ who tried similar experiments on two African species, *Loranthus kraussii* and *L. dregei*, also came to the same conclusion.

Dispersal and Propagation.—The berries which are oval in shape about 10–12 mm × 4–5 mm., with a minute concave cup at the apex, take about a fortnight to reach maturity, i.e., the stage when they become an attraction to the Flower-peckers. If allowed to ripen, they assume a beautiful rosy-red colour in about 20 days. It is not usual, however, to find fully ripe berries on the clumps as they are rarely allowed to remain long enough by the birds, and except when in the greatest profusion (in late January or February, as a result of the heavy winter flush) they are seldom met with in this condition. Usually by the time they have acquired a slightly yellowish tinge and even before—

¹ Blanckenhorn, 'Naturwissenschaftl. Studien am Toten Meer', Berlin 1912. Mr. S. H. Prater of the Bombay Natural History Society also reared a young *Leptocoma zeylonica* on a diet of Golden Syrup mixed with water.

² Tiwary, N. K. 'A Note of the Short Cut by Birds to the Honey in *Sesbania grandiflora*' *Jour. of the Ind. Bot. Society*, 1926, 5, pp. 121–23.

³ Porsch, Otto. 'Vogelblumenstudien I', *Jahrbucher für wissenschaftl. Botanik*, 63, 1924, pp. 553–706.

⁴ Evans, Maurice E., *Nature*, Vol. li, p. 235, Jan. 1895.

as soon as the outer pulp shows signs of softening—they are taken by the Flower-pecker. In every bunch of berries there are several with marks of the birds' beak upon them which have been tested and found unripe. The two common Flower-peckers in Western India which give the berries practically wholetime attention are: *Dicaeum e. erythrorhynchum* and *Piprisoma a. agile*.

Tickell's Flower-pecker (*Dicaeum e. erythrorhynchum*) in my opinion is undoubtedly the most important agent in the dispersal and propagation of the Loranthus parasite. I have studied their feeding habits and also examined the stomach contents of a great many specimens, shot in every month of the year, and find that while Loranthus berries are eaten whenever available, during the season when they are most plentiful they comprise practically the exclusive diet of this species. In addition to these, the other principal items of its food consist of the round, white berries of *Phyllanthus reticulatus*, an indigenous shrub, the berries of that pernicious imported weed *Lantana camara* which has now overrun and devastated thousands of square miles in India, and those of the 'Mistletoe' *Viscum articulatum* another tree parasite common in these parts on a species of wild *Grewia* and on the Ber (*Zizyphus*). Occasionally small spiders are also taken.

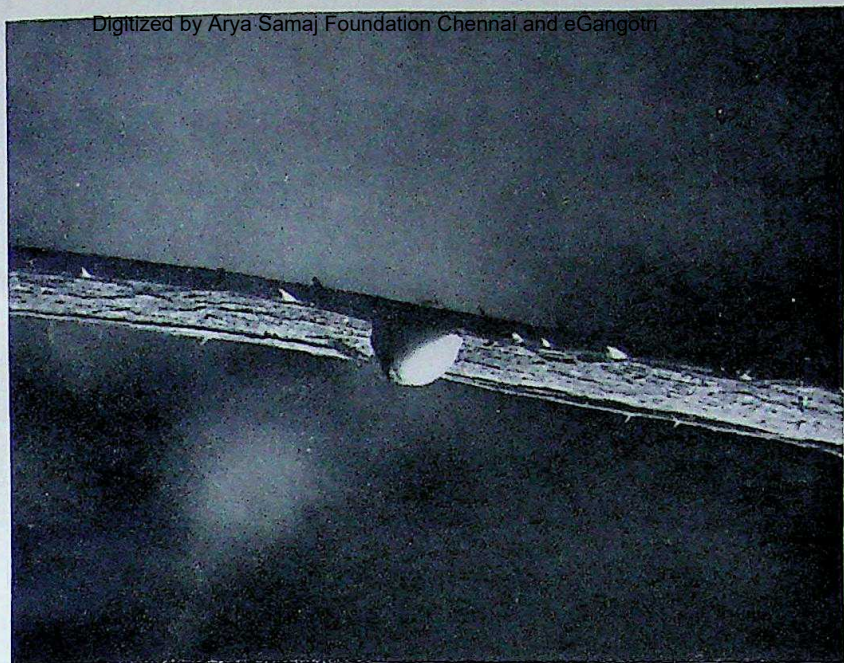
On the whole, its food and feeding habits constitute a serious indictment against the Flower-pecker. Lantana, Loranthus and Viscum are all highly injurious to forestry and arboriculture. All three (except the first whose berries are eaten and scattered by innumerable other birds as well) owe their propagation and existence more or less exclusively to this Flowerpecker and the next species. It has also been frequently accused of damaging ripe mangoes, a charge which my own observations have been unable to confirm. The Flowerpecker seems to have regular beats or feeding territories within which the individuals flit from one Loranthus clump to another at all hours of the day. While on a clump, the bird hops restlessly from bunch to bunch uttering an almost incessant *chik, chik, chik* which is occasionally varied by a series of twittering notes which might be termed its song. Each berry is first tested between the mandibles; if ripe it is plucked and swallowed, broad end (i.e. where the stalk attaches) first. After it has bolted down three or four berries, one after another the bird retires to the extremity of some bare branch at the top of the host or on an adjoining tree and sits quiet for a few moments with the feathers partly puffed out. It is during this interval that the mischief is done, for hardly has the bird been there a couple of minutes than you see him becoming uneasy, and presently one of the viscous seeds is excreted. I have often watched this process carefully through glasses. It appears to involve some effort on the part of the bird, which considering the size of the seed is by no means surprising. The passage of the seed through the intestinal canal and its exit through the anus is no doubt greatly facilitated by the extremely viscous substance in which it is invested. This is clearly evident when a slight pressure is exerted on the abdomen of a freshly killed specimen which very often causes a Loranthus seed to slip out of the vent. The seed is invariably extruded broad-end first—therefore, in the identical position in which it entered the food canal—and

by a final jerky, and dipping motion of the posterior part of the body, during which the bird often pivots round from its normal crosswise position on the branch to one nearly along it, it is passed out. The extruded seed promptly adheres to the perch, slightly to one side of it as shown in the accompanying photograph taken soon after extrusion. (Plate II.)

The discarded seeds measure on an average 10×4 mm. They are copiously covered with viscous matter and in addition have attached at the pointed end a sessile, thread-like, extremely viscid process about 22-25 mm. long. There is also a similar process on the broad-end which is much shorter, measuring about 10 mm. (Fig. 4). These processes resolve themselves into small sticky masses as soon as the seed comes in contact with a branch, helping it to secure its position.

The largest number of seeds taken by me from a single *Dicaeum* is four. One of these was on the point of extrusion and partly out of the vent when the bird was shot. The other three were found in the intestine one behind the other, all with their broad ends in the direction of the vent. In birds the process of digestion is extremely rapid, but in the case of this Flower-pecker it seems to be exceptionally so. The seed probably does not occupy more than 3 or 4 minutes (perhaps even less) after the berry has been swallowed to pass out again. Time and again I have been able to watch the complete process from the swallowing of the berry to the extrusion of the seed, and as the inside of a Flowerpecker can obviously hold only a limited number of berries at a time—presumably not more than 4 or 5—my estimate cannot be far out. Immediately it has got rid of the unnecessary ballast, the bird flies off to some other clump uttering its lively *chik, chik, chik*. The normal method of feeding with *Dicaeum* is to swallow the berries entire. Thus he is responsible not only for conveying the seeds to other branches of the same tree, but also for spreading them further afield to other trees in the neighbourhood. Occasionally I have also seen him pinch and revolve a berry in his finely serrated mandibles, stripping off the fleshy part and wiping the seed on to a nearby twig. This habit, however, is more common with the next species.

The Thick-billed Flower-pecker *Piprisoma agile agile* is also responsible for much mischief in the propagation of the *Loranthus* parasite, though the damage it does is no doubt considerably less. Examination of stomach contents and a study of its feeding habits shows that this species does not swallow the berries entire, except perhaps in very exceptional cases. The bird is in particular evidence on the *Loranthus* clumps between January and March when the berries are in greatest abundance. Like *Dicaeum*, it flits about singly from one clump to another also appearing to have well defined feeding circuits. Its voice and notes are similar to those of the other species only perhaps somewhat shriller and more metallic; but with a little practice the two can easily be distinguished from one another. The bird twists its little tail from side to side as it searches amongst the clumps. The berry is plucked and invariably revolved between the mandibles which being thicker and stouter, appear better adapted to this method of eating. The flesh



Seed of *L. longiflorus* on a branch, photographed immediately on being excreted by *Dicaeum erythrorhynchum*.



Photos
A Chickadee (Parus agilis) with a berry of
L. longiflorus in bill.

Salim A. Ali.

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is soon detached and the seed wiped on to a neighbouring twig by a sweeping side-to-side motion of the head. Occasionally when disturbed at its meal the bird will fly off with a berry in its bill and this is the only way in which *Piprisoma* may spread the parasite to neighbouring trees. On a *Loranthus* clump on a Guava tree near my bungalow which I had under continuous observation, I found that while the berries were present, *Piprisoma* visited the cluster on an average about six times a day. Three or four berries were plucked on each of these visits, whose seeds were wiped on to the adjoining branches, with the result that within a short time there were hardly a couple of inches in a radius of about three feet of the clump free from the adhering seeds. It is on account of this feeding habit of *Piprisoma* that when lopping off branches affected by the *Loranthus* parasite care must be taken that all the adjacent members are likewise removed as these are sure to harbour some of the seeds.

In addition to *Loranthus* berries, the food of the Thick-billed Flowerpecker consists of a great variety of berries and fruits. *Lantana* is a favourite and here again the process of eating is the same as with *Loranthus*, the entire berries being rarely swallowed. It is therefore not responsible for scattering *Lantana* seeds far afield to the extent *Dicaeum* is. Other contents of the stomachs I have examined were pulp of the Jamun fruit (*Eugenia jambolana*) and Peepai figs (*Ficus religiosa*) and also small spiders.

When one considers that these two species, which are by no means uncommon in these parts, are ceaselessly engaged throughout the day and month after month on their task of seed dissemination, one can form a fair idea of their power for evil to humanity and of their vital services to the plants on which they are in turn dependent.

SOME ASPECTS OF THE BIONOMICS OF THE LAC INSECT.

BY

P. S. NEGI, M. P. MISRA and S. N. GUPTA.

*Department of Entomology,**Indian Lac Research Institute, Namkum.*PROPORTION OF MALE TO FEMALE LARVÆ FOR EACH DAY OF
EMERGENCE.

According to Sreenivasaya,¹ Mahdihassan says that the first batch of larvæ to swarm are mainly females, whilst those appearing later are chiefly males. This statement though vague, if correct would prove of great value in lac cultivation. Therefore, to test its accuracy, experiments with a number of individual cells were started in the Katki (July–November) crop in 1928 and repeated during the Baisakhi (November–July) 1928–29 and 1929–30 and the Katki 1929 crops. Each female cell was confined in a small wire gauze case and inoculated on a small plant of Ber (*Zizyphus jujuba*) or Arhar (*Cajanus indicus*). After each 24 hours of emergence the female cell was removed to the next plant, till the emergence of larvæ from the cell stopped.

The identification of sex in the first instar larva of the lac insect is a debatable matter, therefore to avoid controversial points, the inoculated plants were examined for the sex-ratio, only when the male insects had reached the prepupal and pupal stages. The results of these examinations are given in the following tables:—

KATKI 1928.

TABLE I.

COL. I.							
No. of cells out of the total 15, from which emergence took place on days stated in Col. II.							
	15	11	4	5	4	1	1
COL. II.							
Serial No. of days for which emergence continued in the number of cells stated in Col. I.							
	1	2	3	4	5	6	7
COL. III.							
Average percentage of females in the progeny of the cells stated in Col. I.							
	90.2	87.05	88.8	84.09	90.9	50	100

¹ *Ind. Inst. Sc. J.*, Vol. vii, pt. vii, p. 110.

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BAISAKHI 1928-29.

TABLE II.

COL. I.													
No. of cells out of the total 21 from which emergence took place on days stated in Col. II.	21	21	19	17	18	16	16	14	11	6	4	2	1
COL. II.													
Serial No. of days for which emergence continued in the number of cells stated in Col. I.	1	2	3	4	5	6	7	8	9	10	11	12	13
COL. III.													
Average percentage of females in the progeny of the cells stated in Col. I.	44.24	41.4	49.6	56.9	72.2	75.8	87.07	85.7	91.4	82.7	75.0	100	0

KATKI 1929.
TABLE III.

COL. I.										
No. of cells out of the total 15, from which emergence took place on days stated in Col. II.	15	14	14	13	9	9	10	6	3	1
COL. II.										
Serial No. of days for which emergence continued in the number of cells stated in Col. I.	1	2	3	4	5	6	7	8	9	10
COL. III.										
Average percentage of females in the progeny of the cells stated in Col. I.	91.9	84.09	81.4	79.5	91.4	78.9	93.2	79.3	100	100

BAISAKHI 1929-30.
TABLE IV.

Col. I.														
No. of cells out of the total 25, from which emergence took place on days stated in Col. II.														
18	22	25	22	23	22	21	21	15	17	11	11	7	5	4
1														
Col. II.														
Serial No. of days for which emergence continued in the number of cells stated in Col. I.														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16														
Col. III.														
Average percentage of females in the progeny of the cells stated in Col. I.														
63.49	38.03	40.76	45.19	50.18	71.18	74.61	72.22	63.95	85.39	82.02	92.00	88.88	69.23	82.14
50.00														

SOME ASPECTS OF THE BIONOMICS OF THE LAC INSECT 153

The study of the above tables clearly shows that the statement made by Mahdihassan, that the first batch of larvæ which swarm are mostly females and those which appear later are chiefly males, is incorrect; these results also show that the emergence of larvæ from the incubating chamber of the mother is of mixed character and that there is no inter-relation between sequence of emergence and sex ratio.

MOTHER CELLS AND SEX OF THE PROGENY.

In the course of the above study it has been found that:—

I. In the Katki crop (July-October) the progeny of most of the cells of the Baisakhi crop (October-July) develop as is already known into females predominantly; but further it has been noted that the progeny of some of the cells develop into cent per cent females, and in a few cells, the progeny is intermediate between the two.

II. In the Baisakhi crop, the progeny of most of the cells of the Katki crop grow into predominantly female, of a few cells into predominantly male and of some, the progeny is intermediate between the two. Cells producing males and females from 40-60 per cent have been taken as producers of intermediate progeny regarding sex ratio. The results are tabulated below:—

KATKI CROPS 1928 AND 1929.

TABLE V.

	No. of mother cells under observation	Mother cells whose progeny developed mostly into females.		Mother cells whose progeny developed into cent per cent females.		Mother cells whose progeny was intermediate.	
	—	No.	Percentage.	No.	Percentage.	No.	Percentage.
	23	17	73.91	5	21.73	1	4.34
Percentage of females in the progeny of these mothers.	81.2.	80.08		100		53.9	

BAISAKHI CROP 1928-29 AND 1929-30.

TABLE VI.

—	No. of mother cells under observation.	Mother cells whose progeny developed mostly into females.		Mother cells whose progeny developed mostly into males.		Mother cells whose progeny was intermediate.	
	—	No.	Percentage.	No.	Percentage.	No.	Percentage.
	41	24	58.53	5	12.18	12	39.26
Percentage of females in the progeny of these mothers.	63.5	74.6		33.2		51.1	

SWARMING PERIOD.

The number of days over which the emergence of larvæ continues from an individual mother, depends, firstly on the temperature, secondly on the egg-laying capacity of the mother, and thirdly on the rate of egg laying. However, from the daily observations on 31 cells during July inoculations in 1928 and 1929 it has been found that:—

11 days is the maximum period for the emergence of larvæ from an individual mother and 6 days is the average period: while in the October-November inoculation observations on 50 cells show that 16 days is the maximum period for emergence to last from an individual mother and 7 days is the average period. The periods of emergence during the month of February are almost the same as those in October-November provided that the day temperature does not fall below the temperature at which the emergence started. It is also interesting to note that the largest number of larvæ swarming on a single day generally emerge from an individual cell in each crop season between the first and the fifth day of the swarming period.

CHOICE OF BROOD LAC.

Out of 51 apparently healthy mother cells during July inoculations in 1928 and 1929, larvæ failed to emerge from 20 cells. During October-November inoculations the emergence failed from 18 apparently healthy cells out of 68. On examination, dead larvæ in large numbers were found in the incubating chamber of most of the cells. The death of the larvæ in most of these cases proved to be due to the blocking of the anal openings of the lac tests through which the larvæ come out. In the remainder, the female was found to be attacked either by young predator larvæ which seem to have entered the tests through the anal opening, or by full grown parasite grubs. Besides this numerous cases have been noticed in which a mother though apparently quite healthy, for some unknown reason, fails to lay eggs, and consequently no emergence of larvæ takes place. In view of these facts, presumably the best brood for infecting, in cases where available, is one in which the healthy cells are situated closely but separately on the sticks or without much overlapping. This being preferable to brood which has a healthy looking thick incrustation due to excessive overlapping and coalescence of lac tests, because in the latter case there are bound to be a large number of dead and parasitized cells, and also a large number of cells which though living, have the anal openings of their tests blocked, by the neighbouring cells which coalesce and overlap them. This has been further confirmed by numerous observations during the examination of sticks for emergence, etc.

EGG-LAYING PERIOD.

As egg laying is the preliminary stage to the emergence of larvæ, it has been thought advisable to include some results in this connection, obtained from the data collected on fertility in the various broods, and on the effect of temperature and humidity on egg laying. The egg laying period depends like the emergence period, on the temperature during the swarming season, on the vitality of the mother, and on the number of eggs a mother is going to lay. Egg laying will begin in all the three seasons (June-July, October-November, January-February) if the temperature is above 17°C. In winter however it sometimes begins even at 15-16°C. The average egg laying period for an individual mother in all the broods during all the seasons is about 7 days and the maximum about 14 days. The largest number of eggs laid by a mother on a single day is generally laid between the 2nd and 6th day of the egg laying period.

ACKNOWLEDGMENT.

The Authors thanks are due to Dr. C. F. C. Beeson, Forest Entomologist, Dehra Dun, for valuable advice and criticism, and to Mr. P. M. Glover, Entomologist at the Indian Lac Research Institute for advice and correction of the manuscript.

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CONCLUSION.

(1) Sequence of emergence and sex-ratio can hardly be said to be inter-related.

(2) The Baisakhi crop produces females whose progeny in the majority of cases is predominantly female, in some cent per cent female and in a few intermediate between the two.

The Katki crop produces a major number of females whose progeny is predominantly female, a few whose progeny is predominantly male and some whose progeny is intermediate between the two.

(3) Emergence (swarming) period depends on the temperature, egg laying capacity of the mother and rate of egg laying, 11 days seems to be the maximum swarming period for an individual Baisakhi mother cell, and the average period 6 days: for a Katki mother cell 16 days seems to be the maximum swarming period and 7 days the average. The largest number of larvæ swarming on a single day from a mother cell in all the seasons emerge generally between the 1st and 5th day of the swarming period.

(4) The average egg laying period for an individual cell in all the seasons is about 7 days and the maximum is about 14 days. A mother lays the largest number of eggs in a single day between the 2nd and 6th day of her egg laying period.

(5) The best brood lac is that in which healthy cells are situated closely but separately on the stick or are coalesced without much overlapping.

IN A BURMESE JUNGLE

BY

LT.-COL. R. W. BURTON, I.A.R.O. (Retd.)

Rangoon has altered out of almost all recognition since I last saw it in 1891. The golden dome and glittering spire of the Shwe Dagon Pagoda is, as formerly, the most conspicuous object in the landscape as the steamer slowly makes its tortuous approach to the landing stage; but the piles of many stately buildings seem to my eyes to be almost all of them edifices constructed within the past forty years; however one can forget quite a lot in close upon four decades!

The tramways and the motor traffic; the tarmac roads; the fine wide streets; the numerous roadside stalls; are all the outcome of modern development. The streets are thronged with people of all the nations of the East, and gaily painted rickshaws are busily plying in and out among the rapid traffic of the broad roads. The untidy litter scattered all around the street stalls is an offence to the eye, but one's nostrils are not assailed by the many offensive odours of the cities of India. The climate of Rangoon in mid-December is not unpleasant, but even then electric fans are always welcome during most of the daylight hours.

We left the central station next evening at six o'clock, and passing Pegu a couple of hours later, saw on our left the blaze of electric lights which outline the Pagoda and give it the appearance of an enormous Christmas cake. At four in the morning we found ourselves making tea on the platform of Pyinmana junction; and soon after six o'clock were enjoying the scenery of the dense forests of the 'wet zone' as the train wound its way over the lower elevations of the Pegu Yomahs.

The change in the vegetation showed us that we were gradually passing into the 'dry zone', where the rainfall is but 20 to 40 inches as compared with the 60 to 100 of the other, and at twelve o'clock we arrived at Taungdwingyi.

T.G.I., as it is commonly styled for sake of brevity, was for some years the terminus of the railway in this direction, but the line has now been extended, and will eventually join the Thazi-Myingyan branch at the latter place.

Having stayed a day to purchase some local supplies, we next morning went about ten miles by rail, and seven by road, to a forest rest-house. The Forest Range Officer accompanied us and I rode one of his ponies. Both the animals were in beautiful condition and very spirited. The grey cost Rs. 275 and the bay Rs. 180, the former being about 14 hands in height. Our baggage was carried in carts, and I learnt that a cart complete with bullocks cost Rs. 350.

One of the first things which attracted my attention was the splendid condition of the draught cattle, and their untwisted tails, so different to the cruelly distorted appendages of the cattle of India. Ramaswamy, our Rangoon servant, admits that the

undamaged tail is good, but says 'Burman's plenty much beating to make go'; but I noticed that any beating necessary is done with a pliant bamboo and not a rib-roasting cudgel!

Nearing our night's destination we passed the local monastery, situated on rising ground amid umbrageous trees, for these institutions are always established at the most favourable site to be found, and so arrived at the rest-house, a conspicuous building on posts, and forty feet square, the floor level being some ten feet above ground level. The accommodation is two rooms and bath rooms, with a verandah 36 ft. by 16 ft. Overlooking the large village of 80 houses just below us, we had a wide view over the surrounding country. All is forest as far as the eye can see, and away to the north and east are the Yomahs, covered with jungle throughout their length.

In the morning an early start was made to complete the seven more miles to the shooting camp, where there is a small forest village and a rest-house of similar size to that we had just left. The forest was, so far, very similar to that of the Central Provinces of India, and the birds and butterflies seen along the way were apparently of similar species to those of the same tracts.

The object of this trip was to obtain specimens of a bull *saing* and a stag *thamin*. The former is the wild ox of Burma and the Malay States, the latter the Brow-Antlered deer of Burma. For the *thamin*, search had to be made near the village just left; and as there was said to be only one shootable stag, the quest was likely to be somewhat difficult.

On the morning of the 22nd December (1929), I set out before dawn with two trackers: directly overhead was the Great Bear, and the Southern Cross was among the tree tops. Behind us followed a lad, with our requirements for the day slung at either end of a bamboo carried over his shoulder. It was wonderful how silently he kept us in sight throughout our wanderings. The elder tracker was a middle-aged man of the rather womanish type, with gentle expression, of so many Burmans. He wore his hair long, and done up into a bun twisted together on top of his head. In his hand he carried a *dah* with a razor-edged blade about two feet in length, with which he often silently sliced off obstructing twigs and bamboo shoots. None of the jungle Burmese; men, women, or children, leave their houses without a *dah*. As soon as a child can toddle, it carries a *dah*, and I used to see a mother and child going to the jungle for bamboos or what not, the infant with a *dah* as high as itself!

The younger tracker was a finely built fellow with splendid shoulders. He wore his hair short-cropped, as do so many Burmans of the present day, and had a drooping moustache of the Malay type. The elder man was clean shaved.

About two miles from the village we entered a network of ravines. There were some level places here and there, covered with dense vegetation and bamboo jungle interspersed with giant trees, some of the semal (*Bombax malabaricum*) trees being of immense size. Tracks of *saing* were soon found, and by seven o'clock we came up with a small herd. A cow dashed off from

behind a clump of bamboos, and then came the loud snort of the bull which was some distance further on. We saw no more of the beasts, for the dry leaves and unburnt vegetation made silent passage through the forest most difficult. And the watching animal sees all the moves of the game ! But I was not unduly discouraged because I knew of this before starting, and that should fortune not favour me, there would be the almost certainty of success in May-June when proper tracking would be possible.

The next two days were blank, and Christmas Day was spent in camp. On the 26th the fresh tracks of a bull were found in a ravine at the foot of the hills. Following up, we eventually came on the animal. The trackers knew, long before I did, that we were close upon the bull : how I cannot say, as I could not talk to them and all our intercourse was by means of sign language ; I think it was that their ears were sharper than mine. A most prodigious snort, which had a metallic note and something of menace in it, announced that our approach was not undetected. Here my entire want of knowledge of the habits of this animal led me to suppose that the snort was followed by retreat and I went ahead as fast as I could, so giving myself away to the waiting and watching eyes which had the advantage of my seeking ones.

So all the view I got was of a yellowish-brown body as the beast turned and dashed away through the bamboos up the hillside. The horns I did not see, and consoled myself with the reflection that the bull was probably not the typical *old* animal I was in search of as a museum specimen. Anyhow he was too sharp for me !

Another day we got up to a bull which could have been shot, but was allowed to go as his horns had not been seen, and he also showed no white markings. I had read, in a book on sports in Burma that all old bulls have white markings amid the general khaki colouring but discovered by observation of mature bulls in the Ridowing sanctuary that this was not the case. On two days, cows were watched at close quarters. It was most interesting to see the fine animals, all unaware of my being so close to them, and admire their beautifully groomed bright chestnut coats, and white stockings. When a cow at last detected my over-confident peepings and peerings, the field glasses showed the slight raising of her muzzle when she snorted at me. And by this and other occasions it was learnt that there is always a considerable time between snort and departure, and that when the danger has been seen, or the approach heard from some distance, there is no snort, only a silent vanishing.

In many places were tracks of bison, elephant, and sambur ; and one day the fresh tracks of a prowling tiger. In some of the ravines were pools of water, all rapidly drying up, and from one of these the younger tracker speedily extracted a dozen murrel of the small variety (*Ophiocephalus gachua*) by means of a bamboo, and a hook produced from the recesses of his clothing. The bait was found under the boulders of the stream in the form of water crickets.

By the teaching of the Buddhist religion an unpleasant punishment awaits the hunter and the fisherman in their next existence ; and for them there is no possible salvation. The miserable destroyer of animal life dangles by the tongue on a fish-hook, while

demons jerk him into the air, and drop him back into a lake of burning pitch! A bad look-out for myself and the young tracker.

At one time or another I have seen and killed snakes of all the four species deadly to man—Cobra, Daboia, Krait, and Saw-scaled Viper—but the King Cobra, the dreaded Hamadryad, I had never seen:

On the 5th January, when coming at midday down the open sandy bed of a ravine, in which were scattered pools of water, the leading tracker, rounding a bend a couple of paces before me, stood and pointed with his dah. There, right in the open, was a large black snake in the act of mouthing a big frog—a very giant of a frog—preparatory to swallowing it. He was quite unaware of our presence just 24 feet from it, and as we watched, threw out the latter half of his splendid form with one graceful sweeping curve so that it lay directly facing us, and fully extended. Its length was about 12 feet, its colour jet black, and its mouth—into the widely extended jaws of which I looked with my binoculars—was terracotta, the same colour as a tiger's nose. There was a slight whitish marking on its neck which I took to be on the flattened hood.

I had signed to the men behind me not to move, as there was every prospect of seeing the brute get outside its tiffin, but one of them did so, and in a moment up went its head, its eyes glistened as it saw us, and it turned to go up the bank into the forest. I could have taken my rifle from the man behind me and shot it in the neck in the first instance, but was too interested to think of it. Now it was too late. He seemed to just stand on his tail and go up the twelve-foot bank without any effort. Its head went into the hollow of a tree and emerged on the further side. Then his sinuous form made its way parallel to us, along the top of the bank, and disappeared from view. It was about twelve inches or more in girth at the thickest part. Had the snake attacked us, as the species has the reputation of doing, there is no doubt that the keen-edged dah would have sliced it in two as if it were one of the green bamboos which the tracker, practised from his infancy in the use of the weapon, severed every day of his life with just a flick of his wrist. Without such a weapon, or a shot gun, one would be indeed without defence against the attack of the hamadryad. It passed through my mind that one's best defence would be to offer one's sola topee to its gaping jaws and then make the best side exit possible! A blow from a walking stick such as I had in my hand would probably not have baulked the 'spot stroke'. Alas! My camera was out of order, the orange celluloid disc having dropped out.

From the appearance of the inhabitants of this forest village it was evident that they suffered much from malaria, so I was not surprised one day to find myself down with fever. It was a short attack of five days only, and in the intervals there was time to admire the view from the verandah.

Below was a field of millet, bright green but tending to a commencement of ripening. In it was a platform from which, shaded from the sun by a sloping roof of bamboo matting, a boy rattled a

tin and pulled strings connected at different parts of the field to loud sounding wooden clappers. His job was to frighten away parrots, and other birds, eager for the coming grain. Beyond the field was a wide belt of feathery bamboos which were daily losing the brilliant green of the rainy season; and stretching away to the hills is the forest of all shades of green and of brown autumn tints. The teak trees were rapidly becoming destitute of all leaves, but in the ravines and hollows the moisture kept the tree tops green.

The hills have an undulating outline and reach an elevation in places of over 2000 feet. They are wholly covered with forest, the spurs and the ravines being clearly defined by the colour of the foliage. I gazed at the dark places and wondered what beasts were harbouring in them.

In the evening the light softened and the scene was one of wondrous beauty and charm. One listened to the twittering of birds, the sweet whistling note of the green pigeons and screech of parrots, the loud call of the tauk-teh lizard; and from the hamlet came the merry voices of the careless, laughter-loving Burmese women taking their rest after the usual day of toil which is their lot in life. Now they were adorning themselves, combing their hair and powdering their faces. One evening I came upon a bevy of them sitting on stones jutting out of the water in the stream all merry and laughing and looking neat and pretty; though not so tidy or so clean as their sisters in the large villages. This is a jungle hamlet; just a forest village of a dozen houses, built on posts as is the fashion of this country.

Beneath the houses are the cattle and the dogs; the ducks and fowls; the carts and the farming implements; and in the evenings, around the smoking wood fires, are the slanty-eyed little children, solemnly warming themselves in the chilly air: for the temperature falls rapidly after sundown at this time of the year, being as low as 50° before sunrise and as high as 85° in the middle of the day.

After the bout of fever another day or so was spent in roaming the forests from earliest dawn to late in the evening in vain search of the bull *sain*, and then I realized that hoping for a lucky chance would be of no avail and further efforts must await the onset of the rainy season.

Back to the first village we went, passing through patches of charred jungle, for the forest fires had commenced and in all directions could be seen a pall of smoke. The bungalow had suffered slight damage from the earthquake which had roused us at midnight a week before at our last camp: the doors and windows would not close and the posts were about four inches out of plumb. At night, from the verandah, long lines of light could be seen, with here and there huge beacons of leaping flames where the hungry fire had found dense patches of grass and dry bamboo. All this was strange to see after being so long used to the strict fire protection in force in India. It seems that the policy of fire protection was abandoned in Burma some years ago, much to the relief of the jungle people no doubt, and it was with evident delight that the men with me used to expend the best part of a box of matches during the day in the forest.

On the first morning at the new camp I had a glimpse of the solitary stag *thamin*: seeing that he carried a good head and was very dark in colour: and that was all that was seen of him in five days' search! A more cunning and elusive beast I never hunted. So it was exactly a month after entering the jungles that I left them without either of the animals which I had come so far to get.

Having returned to Taungdwingyi, I went the next day by rail to a station on the border of the 'wet zone,' and thence five miles to a forest rest-house near a village where there are *thamin*. Only three days could be spared, and I saw no shootable stag. During long residence in the East one assimilates a certain amount of the oriental frame of mind, the resignation to 'kismet' being, in the present circumstances, of some benefit.

There is still space to say something of the many matters noticed. All the villages are surrounded with a formidable thorn fence, in which are gateways closed at night; this precaution being to protect the inhabitants from robbers and cattle thieves. In the 'wet zone' these fences are of the bamboo stockade type and quite impenetrable by stealthy people. There also were no jungle fires, and the forest was of a most pleasing greenness. Birds of beautiful plumage are numerous and one feels that there is life all about one, a great contrast to the deadly silence of the dry forests in which the leafless trees appeal in vain for moisture and the dry skeletons of numerous dead trees raise ghostly branches to the brassy sky.

There had been no animal voices in the night around the forest hamlet of the first camp; near the 'wet zone' village, after the dark pall of night had closed down on the jungle, the grunting of a panther was heard as he set out on his nightly prowl. And I heard the alarm call of a hind *thamin* as the scent of the brute came to her nostrils, trained by the hereditary instinct of many thousands of years, and the teachings of her mother, to know that here was the beast to be dreaded more than all else in the forest. The call has something of the four-horn and of that of the chital, but is different from either of these. It has a most pleasing and tuneful note.

It was towards the end of May that the quest of the bull *saing* was renewed, and a fine beast with 27-inch horns secured without incident. The accompanying photograph is of another animal, which may be taken to be his twin brother. A shootable *thamin* was not found, as the animals had scattered far and wide on the breaking of the rains. Everywhere the tracks of elephant and bison were seen, and a party of elephant catchers in the vicinity, licensed for kheddah operations, had been successful in capturing eleven animals.

The low-lying forests of Burma are exceedingly oppressive in temperature on the outbreak of the monsoon, so I was glad to close down shikar for a while and enjoy the peaceful repose of a journey down the Irrawaddy River on one of the comfortable steamers of the Flotilla Company, and so end my trip to Burma on a note of quiet enjoyment.

ON A SMALL COLLECTION OF FISH FROM THE BHAVANI
RIVER (S. INDIA).

BY

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(With three text-figures.)

(Published with the permission of the Director, Zoological Survey of India.)

This note is based on a small collection made by Lt.-Col. R. W. Burton in the Bhavani River in the Coimbatore district, South India. The specimens were sent to Dr. S. L. Hora by the Curator of the Bombay Natural History Society. I am indebted to Dr. Hora for kindly placing the material in my hands for study. My best thanks are due to Lt.-Col. R. B. Seymour Sewell, Director of the Zoological Survey of India, for his kindness in going through the manuscript.

The collection comprises ten specimens only, which represent nine different species. In view of the fact that some of the species contained in the collection are hitherto known only from short and inadequate descriptions, opportunity is hereby taken to supply such additional or emended descriptions as are necessary for convenience of future reference from the present well-preserved specimens. The local Telugu names for the species are quoted from a list accompanying the collection.

Callichrous bimaculatus (Bloch).

1794. *Silurus bimaculatus*, Bloch, *Nat. Ausl. Fische*, VIII, p. 24.
1877. *Callichrous bimaculatus*, Day, *Fish. India*, p. 476, pl. cx. figs. 4 & 5.
1889. *Callichrous bimaculatus*, Day, *Faun. Brit. Ind., Fish.* I, p. 131, fig. 57.
1927. *Callichrous bimaculatus*, Rao & Seshachar, *Half-yearly Journ. Mysore Univ.*, I, No. 2, p. 5.
1930. *Callichrous bimaculatus*, Prashad & Mukerji, *Journ. Bombay Nat. Hist. Soc.*, XXXIV, p. 165.

The entire body is dusky with the exception of the belly which is white. A round blackish blotch is present behind each opercle. The maxillary barbels are blackish, but the mandibulars are white.

One specimen ... 98 mm. long.
Local name ... *Sottlah barai*.

Aoria punctatus (Jerdon).

1849. *Bagrus punctatus*, Jerdon, *Madras Journ. Lit. & Sci.*, XV, p. 339.
1877. *Macrones punctatus*, Day, *Fish. India*, p. 445, pl. c, fig. 3.
1889. *Macrones punctatus*, Day, *Faun. Brit. Ind., Fish.* I, p. 153.
1927. *Macrones punctatus*, Rao & Seshachar, *Half-yearly Journ. Mysore Univ.*, I, No. 2, p. 8.

The width of the head is equal to the length from the middle of the distance between the anterior border of the eyes and the nostrils to the posterior margin

of the operculum. Its height is less than half its total length. The diameter of the eyes is contained 7 times in the length of the head, almost $2\frac{1}{2}$ times in the length of the snout and the interorbital space. The pectoral spines are as long as the head behind the middle of the eyes. The external mandibular barbels extend beyond the base of the pectorals.

The fish has the characteristic colouration as described by Day.

One specimen ... 200 mm. long.
Local name ... *Kori tee*.

Barbus arulius (Jerdon).

1849. *Systomus arulius*, Jerdon, *Madras Journ. Lit. & Sci.*, XV, p. 317.

1877. *Barbus arulius*, Day, *Fish. India*, p. 575, pl. xiii, fig. 5.

1889. *Barbus arulius*, Day, *Faun. Brit. Ind., Fish. I*, p. 322.

1909. *Barbus arulius*, Annandale, *Rec. Ind. Mus.*, III, p. 289.

Besides the two specimens of the species from the Bhavani River I have also examined the following specimens preserved in the collection of the Zoological Survey of India and the measurements and description given below are based on a study of all the specimens:—

2732 (Figured by Day)	...	Wynaad	...	Purchased from Day	...86mm
F5531/1	...	The Nilgiris	...	" "	...38mm.
F2555/1	...	Tenmalay, Tra-	Annandale Coll.	...	37mm.
		vancore.			
F2556/1, F8069/1	...	Kalatupuzhal	" "	" "	...34mm.

The length of the head is contained from $3\frac{1}{2}$ to $3\frac{3}{4}$ times in the length of the body without the caudal fin. Its breadth is equal to its length behind the anterior third or the middle of the eyes. The height is almost equal to the length behind the anterior nostrils. The diameter of the eyes is contained $3\frac{1}{2}$ times in the length of the head. The snout is as long as the eyes while the interorbital region which is flat, is slightly less than one diameter in width.

A pair of very thin and short maxillary barbels¹ are present. They are shorter than the diameter of the eyes. In all the young specimens, however, the barbels are proportionately longer. The dorsal fin is inserted nearer to the tip of the snout than to the base of the caudal. Its outer margin is more or less straight. The last undivided dorsal ray is osseous but fairly weak. The pectorals are equal to the length of the head behind the anterior margin of the orbit and are separated from the base of the ventrals by a short distance; but in young forms they very nearly reach the ventrals. The ventrals are situated just below the last undivided dorsal ray and are slightly longer than the pectorals. They extend only to the anal opening. In some fairly grown-up specimens as well as in the immature ones, however, they very nearly reach the anal; which latter when laid flat does not meet the base of the caudal. The caudal is longer than the head and its own height.

There are 23-24 scales along the lateral line and 7 rows in a transverse series; $4\frac{1}{2}$ rows being between the dorsal fin and the lateral line and $2\frac{1}{2}$ rows between the lateral line and the base of the ventral fins. There are 8 predorsal scales. The bases of the dorsal, anal and caudal fins are scaly. A prominent, fairly deep pectoral pit is characteristic of the species.

The general body colouration is olivaceous green. The portion above the lateral line is blackish. There are three black blotches on the sides of the body.

Two specimens ... 66 mm. long.
Local name ... *Pewal kendi*

¹ Day's specimen from the Nilgiris has two pairs of barbels. The maxillaries are very long. They extend up to the posterior margin of the opercles and are about $2\frac{1}{2}$ times the diameter of the eyes. The rostrals are much shorter and reach beyond the middle of the eyes. The specimen bears a close resemblance to *B. arulius* but owing to its bad state of preservation does not allow of any detailed examination.

Measurements in millimetres.

	No. 2732	Bhavani R.	F ⁸⁰⁶⁹ 1
Length of body without caudal ...	86.0	66.0	37.0
Height of body	31.0	26.0	12.5
Length of head	24.0	20.0	11.0
Breadth of head	14.5	11.0	7.0
Height of head	20.0	16.0	9.0
Length of snout	7.25	6.0	3.0
Diameter of eyes	7.5	6.0	4.0
Interorbital width	7.0	6.0	3.5
Height of dorsal fin	16.5	16.0	11.0
Height of last undivided dorsal ray...	12.5	12.0	8.0
Length of anal fin	15.0	14.0	6.0
Length of pectoral fins	18.0	14.5	8.25
Length of ventral fins	19.5	15.0	9.0
Length of caudal fin ... ..	...	22.5	12.5
Length of caudal peduncle	12.0	11.0	5.5
Least height of caudal peduncle ...	11.0	10.0	5.0

Barbus carnaticus (Jerdon).1849. *Systomus Carnaticus*, Jerdon, *Madras Journ. Lit. & Sci.*, XV p. 315.1878. *Barbus Carnaticus*, Day, *Fish. India*, p. 563, pl. cxxxvii, fig. 3.1889. *Barbus Carnaticus*, Day, *Faun. Brit. Ind., Fish.*, I, p. 305.

The following specimens of the species are preserved in the collection of the Zoological Survey of India and have been examined:—

2312	...	Canara	...	Purchased from Day	...	62 mm.
2379	...	Bowanny	...	"	"	240 mm.
2410	...	Bowanny	...	"	"	35 mm.

D. 4/7; A. 3/5; P. 1/14; V. 1/8.

The length and the height of the head varies from $4\frac{1}{4}$ to $4\frac{3}{4}$ and 3 to $3\frac{3}{4}$ times respectively in the length of the body without the caudal, while its breadth is equal to its length behind the anterior margin, or anterior third or the middle of the eyes. The height of the body varies with age and is equal to the length of the head behind the anterior nostrils in fairly grown-up specimens while in young forms it is much less and equals the length of the head behind the anterior margin of the eyes. The diameter of the eyes is contained from 3 to $3\frac{1}{4}$ times in the length of the head. The snout is as long as the diameter of the eyes or slightly shorter. The interorbital space is flat and is from 1 to $1\frac{1}{4}$ times the orbital width. The lips are moderately fleshy. The upper jaw is slightly longer than the lower and considerably protrusible. The

maxillary barbels are thin and as long as the diameter of the eyes, while the rostrals are considerably shorter. In grown-up specimens there are series of flat tubercles on the snout.

The insertion of the dorsal fin is considerably nearer to the tip of the snout than to the base of the caudal. The last undivided dorsal ray is strong and slightly curved inwards. In grown-up specimens it is as high as the body below it up to the insertion of the lateral line but in younger forms it is equal to or $\frac{4}{5}$ the body height. The outer margin of the dorsal fin is slightly concave. The pectorals are as long as the head, but are much smaller in young individuals. They are separated from the base of the ventrals by a short distance. The origin of the ventrals is almost vertically below the insertion of the dorsal. They are slightly shorter than the pectorals and separated from the base of the anal. The insertion of the anal is almost equidistant from the base of the caudal and the origin of the ventrals. It is as long as the ventrals and, in some specimens, when laid flat, reaches the base of the caudal. The caudal fin is longer than the head and almost as high as long.

The scales are moderately large and there are 28-29 scales along the lateral line and 9 rows in a transverse series, $5\frac{1}{2}$ rows being between the base of the dorsal fin and the lateral line and $3\frac{1}{2}$ rows between the lateral line and the base of the ventrals. In specimen No. 2312 from Canara, however, there are only 8 rows of scales in a transverse series ($4\frac{1}{2} + 3\frac{1}{2}$). The number of predorsal scales varies from 10 to 12. The dorsal, anal and caudal fins have scaly sheaths at the bases.

The colouration of the body is dark olivaceous green above the lateral line and lighter below. The outer margins of the scales are tipped with blackish pigments. There are 4 to 5 very fine and faint blackish longitudinal stripes along the body above the lateral line. The outer margin of the dorsal fin is blackish. All the fins are dusky. The rostral barbels are black.

One specimen... 120 mm. long.

Local name ... *Shole kenti*.

This species is popularly known as Carnatic carp. It is, however, 'doubtful how far this designation has any scientific basis, for, certain other species so called have no more than a distant resemblance to *Barbus carnaticus* (Jerdon).'¹

Measurements in millimetres.

	No. 2379	Bhavani R.	No. 2312
Length of body without caudal fin ...	240.0	120.0	62.0
Height of body ...	78.0	35.0	17.0
Length of head ...	51.0	27.5	16.0
Breadth of head ...	36.0	18.0	8.5
Height of head ...	44.0	21.5	12.0
Length of snout...	16.5	7.5	4.5
Diameter of eyes ...	15.25	9.0	5.5
Interorbital width ..	23.0	11.0	4.5
Height of dorsal fin ...	49.0	26.5	15.5
Height of last undivided dorsal ray ...	42.0	26.5	15.5
Length of anal fin ...	53.0	20.0	10.0

¹ Annandale, N.—*Rec. Ind. Mus.* XVI, p. 135 (1919).

	No. 2379	Bhavani R.	No. 2312
Length of pectoral fins ...	52.5	24.0	12.0
Length of ventral fins ...	51.0	21.0	11.0
Length of caudal fin ...	59.5	33.5	...
Length of caudal peduncle ...	31.5	16.5	8.0
Least height of caudal peduncle ...	30.0	14.0	7.0

***Barbus micropogon*, var. *mysorensis* Jerdon.**

1849. *Barbus mysorensis*, Jerdon, *Madras Journ. Lit. & Sci.*, XV, p. 312.

Jerdon originally described the form from 'Cavery and its tributaries' in South India. His description is, however, very short and the only chief differentiating character that he mentioned is that the 'snout is prominent, raised, covered with mucous pores'. Day merged Jerdon's form in the synonymy of *B. micropogon* (Cuv. et Val.) and did not give it any status beyond saying that 'The variety *B. mysorensis*, Jerdon, has numerous large pores on the snout and preorbital.'¹ Besides the specimen from the Bhavani River, which I assign to Jerdon's form there is another similar but much bigger specimen (No. 2411) from 'Bowanny' (apparently Bhavani or Bhawani) in the collection of the Zoological Survey of India. This specimen bears a tag with the legend '*Barbus micropogon* (var.)' in Day's handwriting. I have very thoroughly examined the two specimens mentioned above and compared them with Day's *forma typica* of *B. micropogon* (No. 2398: figured by Day in his *Fishes of India*, pl. cxxxvi, fig. 3), from 'Wynaad' and have arrived at the definite conclusion that both the specimens from the Bhavani River, although closely allied to *B. micropogon*, are sufficiently distinct from it in the general outline of the body, the shape and size of the snout, etc. (Text-figs. 1 & 2) and should, therefore, be considered as a distinct form.

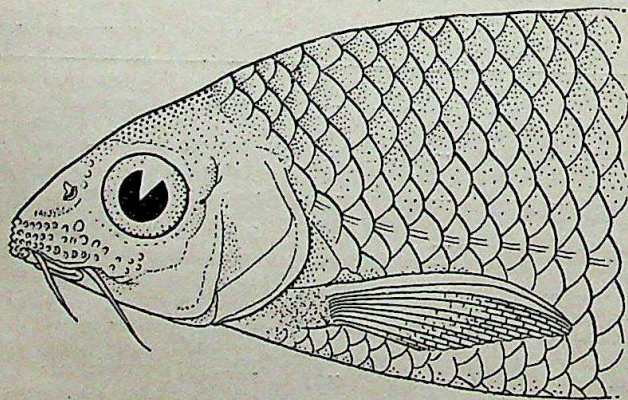


Fig. 1.—Lateral view of anterior portion of Day's specimen of *Barbus micropogon* var. *mysorensis*. (Nat. size).

D. 4/9; A. 3/5; P. 1/14; V. 1/9.

The head is short and cone-shaped. Its length is contained $4\frac{1}{2}$ times in the length of the body without the caudal. The breadth is equal to its length

¹ Day, *F. Fishes of India*, p. 563 (1878).

behind the anterior third of the eyes. The height equals its length excluding the snout. The eyes are situated in the middle of the head; they are fairly large and are contained $3\frac{1}{2}$ times in the length of the head. The interorbital region is more or less flat and is wider than the diameter of the eyes. The snout is obtusely pointed, longer than the orbital width and covered with series of horny cone-shaped and pointed tubercles which extend as far back as the anterior margin of the eyes. There are some similar tubercles on the preorbital region also. The mouth is horse-shoe shaped and its gape is moderate. The lips are fleshy. The maxillary barbels are longer than the diameter of the eyes while the rostrals are about $\frac{1}{2}$ the length of the maxillaries.

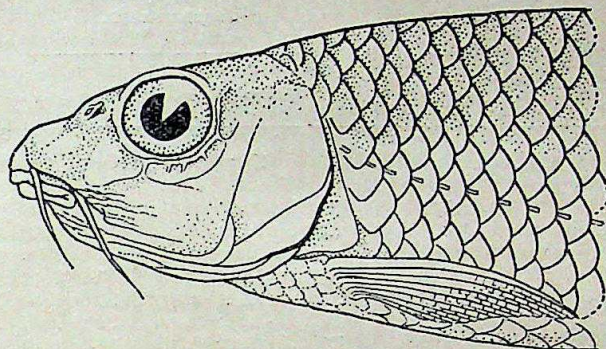


Fig. 2.—Lateral view of anterior portion of Day's specimen of *Barbus micropogon*. (Nat. size).

The dorsal fin is situated nearer to the tip of the snout than to the base of the caudal. Its outer margin is concave. The last undivided dorsal ray is smooth, very strong, flat and is almost as long as or slightly longer than the depth of the body below it. The base of the dorsal is equal to the length of the head behind the anterior margin or anterior third of the orbit. The pectorals are considerably shorter than the head and are separated from the origin of the ventrals by a short distance. The ventrals are inserted vertically below or slightly posterior to the insertion of the dorsal and are almost equal to or a little shorter than the pectorals. They are separated from the origin of the anal by a distance equalling half its own length. The anal is inserted midway between the origin of the ventrals and the base of the caudal. It is rather short with a more or less rounded outer margin, and, when laid flat, extends only to the middle of the caudal peduncle. The caudal fin is deeply furcate with equal pointed lobes. It is nearly $1\frac{1}{2}$ times longer than high. The scales are regularly arranged. There are 41-42 scales along the lateral line, 11 rows ($7\frac{1}{2} + 3\frac{1}{2}$) in a transverse series and 15 before the dorsal fin.

The general colouration of the body is olivaceous green with the dorsum comparatively dark. The outer margin of the dorsal and the anal fins are faintly tipped with black.

One specimen ... 135 mm. long.
Local name ... *Korhi arranz*.

The following table shows some of the chief characters that differentiate Jerdon's form from *B. micropogon* (*sensu stricto*):—

<i>B. micropogon</i> var. <i>mysorensis</i> .	<i>B. micropogon</i> .
1. Head $4\frac{1}{2}$ times in length of body.	1. Head less than 4 times in length of body.
2. Snout pointed and covered with pointed tubercles.	2. Snout blunt and without tubercles.
3. Anal fin when laid flat extends to the middle of caudal peduncle.	3. Anal fin when laid flat extends to the base of caudal fin.
4. 41-42 scales along lateral line.	4. 38-39 scales along lateral line.
5. 14-15 predorsal scales.	5. 12 predorsal scales.

Rao and Seshachar (*op. cit.*, p. 16) reported a form under the denomination *B. micropogon* from Mysore and observed that 'Mysore is known for its very large specimens of this fish. Especially the Cauvery supplies us a very large number of these fish.' Since 'Cauvery' is the type-locality of Jerdon's form, it seems probable that the authors had the variety *mysorensis* before them.

Measurements in millimetres.

	<i>B. micropogon</i> var. <i>mysorensis</i> .		<i>B. micro-</i> <i>pogon</i> .
	No. 2411.	Bhavani R.	No. 2398.
Length of body without caudal fin ...	170	135.0	152.0
Height of the body ...	48.0	39.0	43.0
Length of head ...	38.0	34.0	40.0
Breadth of head ...	22.0	22.0	23.0
Height of head ...	28.5	25.0	28.0
Length of snout ...	15.0	12.0	14.0
Diameter of eyes ...	12.0	11.0	11.5
Interorbital width ...	13.5	11.0	11.5
Height of dorsal fin ...	43.0	42.0	42.0
Height of last undivided dorsal ray ...	42.5	41.5	42.5
Length of anal fin ...	29.0	22.5	28.5
Length of pectoral fins ...	32.5	29.0	30.0
Length of ventral fins ...	31	27.0	27.0
Length of caudal fin ...	35.0	...	40.0
Length of caudal peduncle ...	28.5	23.5	21.0
Least height of caudal peduncle ...	18.0	15.0	16.0

Danio (*Danio*) *æquipinnatus* (McClell.).

1839. *Perilampus æquipinnatus*, McClelland, *Asiat. Research*, XIX (2), p. 383, pl. lx, fig. 1.
 1878. *Danio æquipinnatus*, Day, *Fish. India*, p. 596, pl. cl. fig. 5.
 1889. *Danio æquipinnatus*, Day, *Faun. Brit. Ind., Fish*, I, p. 356, fig. 111.
 1929. *Danio æquipinnatus*, Prashad & Mukerji, *Rec. Ind. Mus.*, XXXI, p. 20.

Myers¹ observes that in this species the insertion of the anal is 'under about the ninth dorsal ray'. I have examined a large series of specimens of this species from various localities in India, Burma, Siam, etc., and find that the anal is situated vertically below the sixth or the seventh dorsal ray. Further, according to him the rostral barbels are 'as long as eye'. But in all the specimens that I have examined they are generally half to three-fourths the orbital width.

One specimen ... 61 mm. long.
 Local name ... *Orichik condee*.

¹ Myers, G. S. - *Amer. Mus. Novitates*, No. 150, p. 3 (1924).

Barilius gatensis (Cuv. et Val.).

1844. *Leuciscus gatensis*, Cuvier & Valenciennes, *Hist. Nat. Poisson*, XVII, p. 309, pl. 503.
 1878. *Barilius gatensis*, Day, *Fish. India*, p. 592, pl. cxlix, fig. 2.
 1889. *Barilius gatensis*, Day, *Faun. Brit. Ind., Fish.*, I, p. 349.
 1924. *Barilius gatensis*, Fowler, *Acad. Nat. Sci. Phila.*, lxxvi, p. 78.

I have examined Day's two specimens of the species (Cat. 871) from the Nilgiris and I find that in both of these as well as in the individual from the Bhavani River, there are present very thin and short maxillary barbels. The specimens are provided with a series of small pointed tubercles on the snout, some portion of the cheek and the lower jaw. The pectoral fins are as long as the head behind the anterior third of the eyes and almost reach the ventrals, which latter extend only to the vent. The length of the anal fin is as long as the length of the head behind the middle of the eyes.

There are 12 vertical black bars descending from 3 scales below the dorsal line. Six or seven smaller and much narrower bars originate from a couple of scales below and alternate with the first series. They extend further down than those in the first row.

One specimen ... 73 mm. long.
 Local name ... *Wa-nati kendi*.

Scaphiodon brevidorsalis (Day).

1873. *Semiplotus brevidorsalis*, Day, *Proc. Zool. Soc. London*, p. 239.
 1877. *Scaphiodon brevidorsalis*, Day, *Fish. India*, p. 552, pl. cxxxiii, fig. 2.
 1889. *Scaphiodon brevidorsalis*, Day, *Faun. Brit. Ind., Fish.*, I, p. 286, fig. 98.¹
 1927. *Scaphiodon brevidorsalis*, Rao & Seshachar, *Half-yearly Journ. Mysore Univ.*, I, No. 2, p. 15.

D. 3/11; A. 3/5; P. 1/13; V. 1/9.

The length of the head, of the caudal fin and the height of the body are contained 4 $\frac{1}{2}$, slightly less than 4 and a little over 3 times respectively in the length of the body without the caudal. The eyes are situated almost in the middle of the length of the head and are contained 3 times in the length of the latter. There are several rows of small tubercles across the snout.

The origin of the dorsal fin is nearer to the tip of the snout than to the base of the caudal. The last osseous ray is shorter than the longest branched ray and is nearly equal to the length of the head. The pectorals are slightly shorter than the length of the head and do not extend to the base of the ventrals which latter are as long as the former and do not quite reach the base of the anal.

The body above the lateral line is dusky while the portion below is yellowish to white. There is a blackish band along the lateral line from behind the angle of the opercles to the base of the caudal fin.

One specimen ... 76 mm. long.
 Local name ... *Patty kendi*.

Scaphiodon nashii (Day).

1868. *Barbus Nashii*, Day, *Proc. Zool. Soc. London*, p. 584.
 1877. *Scaphiodon Nashii*, Day, *Fish. India*, p. 552, pl. cxxxiii, fig. 3.
 1889. *Scaphiodon nashii*, Day, *Faun. Brit. Ind., Fish.*, I, p. 285.
 1927. *Scaphiodon nashii*, Rao & Seshachar, *Half-yearly Journ. Mysore Univ.*, I, No. 2, p. 15.

¹ The figure 98 in the *Fauna of British India, Fishes*, I, p. 286, has wrongly been referred to *Scaphiodon brevidorsalis* by Day. It is, in fact, a reduced replica of the figure of *Scaphiodon nashii* published in his *Fishes of India*, pl. cxxxiii, fig. 3.

D. 3/11; A. 3/5; P. 1/13; V. 1/9.

The length of the head, of the caudal fin and the height of the body are contained $4\frac{1}{2}$, $3\frac{1}{2}$ and $3\frac{1}{2}$ times respectively in the length of the body without the caudal fin. The head is slightly higher than broad. The eyes are situated almost in the middle of the length of the head. The interorbital space is more or less flat and equal to $1\frac{1}{2}$ the diameter of the eyes. The snout is slightly longer than the orbital width, and covered with series of tubercles.

The mouth is very characteristic (Text fig. 3). It is small and horse-shoe shaped with rather thick and continuous lips. The horny covering of the lower jaw is somewhat swollen but not very hard. Day¹ observes that the 'mouth in this species alters so with age, that until I had compared specimens of my *Osteochilus malabaricus*² with gradations of *Scaphiodon Nashii* since obtained I could not have believed in their being identical. In the young the jaws are compressed, each with a cartilaginous covering; the lips are thick and continuous, not continued across the chin. As age increases the mouth widens, the cartilaginous covering becomes more horny, and the colour of the fish alters.' This description agrees very closely with the character of the mouth of the specimen from the Bhavani River.

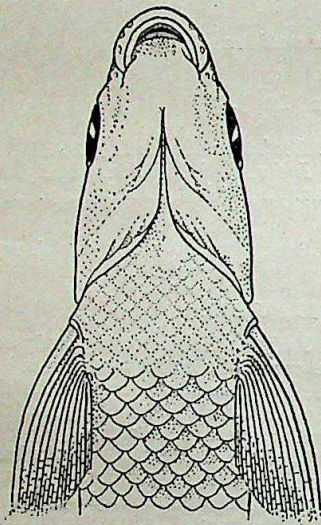


Fig. 3.—Ventral view of *Scaphiodon nashii* from Bhavani River. x $1\frac{1}{2}$.

The origin of the dorsal fin is much nearer to the tip of the snout than to the base of the caudal. The longest ray of the dorsal fin is nearly $1\frac{1}{2}$ times in the depth of the body below it. The last undivided dorsal ray is rather weak. The base of the dorsal fin is almost equal to its height. The outer margin is more or less straight. The pectorals are falciform, slightly smaller than the head and separated from the origin of the ventrals by a considerable distance. The ventrals are inserted vertically below the 4th branched ray of the dorsal, shorter than the pectorals and extend to the anal opening. The anal is twice as long as it is broad at the base and does not quite reach the caudal. The caudal is deeply furcate and is longer than it is high at its free end. The central rays which are the shortest are about $4\frac{1}{2}$ times in the entire length of the fin.

There are 40-41 scales along the lateral line, $12\frac{1}{2}$ rows in a transverse series, $7\frac{1}{2}$ rows being above the lateral line and 5 rows between the lateral line and the base of the ventrals. In front of the origin of the dorsal there are 18 scales. The colouration of the specimen agrees entirely with Day's description.

One specimen ... 115 mm. long.
Local name ... *Kari moti kandi*.

Remarks.—In general facies, character of the pharyngeal bone and teeth, etc., the specimen agrees perfectly with a *Scaphiodon*. The proportions of its body, the position and composition of the fins and the characteristic colouration highly suggest that it is *S. nashii*. It is only the shape of the mouth and the character of the lips that are unlike a *Scaphiodon*. Unfortunately, I have no authenticated material of this species at my disposal at present for comparison, and I have, therefore, greatly relied on Day's remarks in regard to the variability of the shape and size of the mouth and the lips in this species.

¹ Day, F.—*Fishes of India*, p. 552, foot-note.

² In all probability this is a misnomer. Day does not seem to have called anything by this name.

FISH FROM THE BHAVANI RIVER

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Measurements in millimetres.

					Bhavani R.
Length of body without caudal fin	115.0
Height of body	...	...	...	...	35.0
Length of head	...	...	...	...	25.0
Breadth of head	...	...	...	...	16.0
Height of head	...	...	...	...	19.0
Length of snout	...	...	...	...	9.0
Diameter of eyes	...	...	...	...	8.0
Interorbital width	...	...	...	...	10.0
Height of dorsal fin	...	...	...	...	23.5
Height of last undivided dorsal ray	...	...	...	...	23.5
Length of anal fin	...	...	...	...	23.0
Length of pectoral fins	...	...	...	...	24.0
Length of ventral fins	...	...	...	...	23.5
Length of caudal fin	...	...	...	...	34.5
Length of caudal peduncle	...	...	...	...	17.0
Least height of caudal peduncle	...	...	...	...	14.0

THE BUTTERFLIES OF THE SIMLA HILLS

BY

G. W. V. DE RHE-PHILIPPE, F.E.S.

Part I

The passion for collecting something is ingrained in most of us, and Nature around very frequently provides the material for the satisfaction of this trait in our characters. Yet, in spite of its wonderful wealth of insect life, the collection and study of butterflies and moths is not exactly a 'popular' hobby in India. For one thing, there is, as a rule, too little leisure; and the climate, except perhaps in the Hills, is apt to discourage and damp the enthusiasm of the few who have the time and inclination for the field work which is not only an important but also the most fascinating side of the pursuit of any branch of Natural History. But more responsible than anything else for this lack of interest is perhaps the fact that the path of the aspiring entomologist or botanist to the deeper knowledge by which alone interest can be maintained is so beset with difficulties. He has not, as in England and America, comparatively cheap and easily obtainable hand-books on his subject to aid and encourage him through his early perplexities of classification and nomenclature; nor has he, to any appreciable extent, the stimulation provided by the example of others with the same bent, or the advantages of companionship and co-operation in mutual interests enjoyed in the membership of Natural History Associations and Clubs.

There is little doubt, however, that the study of the Indian Lepidoptera is beginning to appeal to a much wider circle than has hitherto been the case. Till now, the field of butterflies has been limited to a comparatively small group of workers such as Atkinson, Marshall, Watson, Bingham, Bell, deNiceville and Evans, whose attentions have been directed more to the butterflies of India as a whole, and whose books are the standard works on the subject. India is, however, almost a continent with large areas which are quite distinctive climatically and zoologically; and unless the fauna of each of these is studied and listed, the records of distribution of species and races must, to some extent, be incomplete. Brigadier Evans' latest work, the 'Identification of Indian Butterflies', which recently appeared in the *Journal of the Bombay Natural History Society* and has since been published in book form, has brought these records up to the limits of our present knowledge; and the fact that he has not only been able to extend the previously known distribution of some species, but has also been able to add some new species and to separate clearly differentiated local races of many old species, is in itself proof that there is still work to be done.

There is another direction in which our knowledge of Indian butterflies is still very backward. This is in connection with the egg, larval and pupal stages of the life history of a large number of species. Mr. T. R. Bell has broken new ground here, and his papers on the 'Common Butterflies of the Plains of India', which also appeared in the *Journal*, have done much towards adding to our former scanty store of information. But his work has lain more in the districts of Western and Southern India, and there is still a large field for similar observation and study in the northern and eastern areas and in Burma. In India, unfortunately, this branch of work presents some difficulties. It needs some degree of settled residence, not interrupted by long absences from headquarters and not subjected to sudden transfers; and it demands time and infinite patience. There are not too many folk in India who work under these happy conditions; but there is so much to be done that it is to be hoped that naturalists in these localities, with inclination and facilities for this side of the subject, will turn their attention to it and record the results.

Still, there is much useful work which can be done even by those who cannot find opportunities for breeding and studying the earlier stages of their butterflies. Gaps in our knowledge of butterfly life in India have yet to be filled; and this can be done by the observation, study and listing of the species and races to be found in each of the districts of the country, with notes of the times and periods of their appearance, nature of the localities usually affected by each, and descriptions of seasonal and other variations, if any. Such lists not only provide specialist students with valuable information as to the distribution of species and local races and phases of their life-history, but will also, if available and obtainable, encourage and help many others who, I am sure, are collectors and students in embryo, but who are deterred from anything beyond mere 'collecting' by the absence of literature on their hobby.

Some particular localities in India have already been worked over by a few enthusiasts. The results have been recorded and may be found in the Journals of the Bombay Natural History Society, of the Asiatic Society of Bengal, and occasionally in the Transactions and Proceedings of the Zoological and Entomological Societies of London. It is unfortunate that these are not easily traceable and not always readily obtainable; but they do exist, and any one who is keen could probably get copies of what he wants by enlisting the aid of the Societies. A list of these 'Lists' or papers would be useful and I hope at some future date to get one out.

Some of these lists were made up very many years ago and could probably be revised and brought up to date with advantage; while there is little doubt that all could be added to from time to time. And the lists we have, do not, by any manner of means, complete the Indian region. The Madras plains and the Mysore plateau have certainly not been fully explored, nor have the Eastern coastal districts and Ghats where a very interesting butterfly fauna should be found. The upland plains of Central India and Chota Nagpur, with their broken-up hills and large areas of forest country, must be the home of many fine insects, but, though we know of many to be found there, we have no really complete list of the butterfly inhabitants. Assam is a butterfly collectors' paradise, and though we have records of what may be found in the Khasi Hills, the Naga Hills and in Cachar, these cover only a small portion of its hill country and there is yet much to learn of the insects of its river valleys and its vast forests. Parts of the long Gangetic Plain and of the Punjab and much of the arid deserts of Rajputana and Sind still remain to be worked up. Very little is known of the butterflies of Baluchistan and the North-West Frontier regions, where we get a quite distinct type of fauna. And there are still many gaps in the listing of the long stretch of the Himalayan Range with its gradual variations of fauna from the Palearctic type of the extreme northwest to the Indo-Malayan groups of the East.

One of these gaps is the area from and including Kashmir in the north to Mussoorie and its environs in the south-east. Brigadier Evans has given us a list of the butterflies in the Chitral country, and Mr. Mackinnon, years ago, made a very complete catalogue of what were found in and around Mussoorie. It might be thought that these two lists would be a sufficient guide to the fauna of the intervening tracts of the same mountainous country, but it is rather an interesting fact that this is not the case. The Chitral butterflies are distinctly and preponderantly Palearctic; and as we proceed south-eastwards there is a gradual but quite definite change till, by the time we reach Mussoorie and Kumaon, there is a strong element of the eastern fauna. Several species are, it is true, to be found throughout this stretch of country; but there are others which while common in, say Kashmir, are distinctly rare by the time we get to Dalhousie and will not be found at all in the Simla District. Conversely, there are quite a number of species which figure in the Mussoorie lists and are not rare there, which are scarcer and scarcer as we proceed west and finally disappear altogether from the local fauna.

With its large European population and its schools, there are probably more collectors of sorts in Simla than in any other locality in India, the Darjeeling Hills perhaps excepted. In my butterfly expeditions round Simla, I met many more folk—grown-up people, not only schoolboys—with nets and collecting impedimenta than I had done anywhere else in all my wanderings in India. It was quite a common experience, when exploring some likely nullah, to come across one or two others bent on the same mission; and there were

far more opportunities for talking 'butterflies' than is usually the case in an Indian station.

Yet, strange though it may seem, there appears to be no list or account of the butterflies which are to be found in the hill districts of which Simla is the headquarters. At any rate, I have not been able to discover any such compilation, and I know of others anxious to obtain information who were equally unsuccessful. I propose, in this paper, to try and supply this want; and I hope it will be of use, not only to the many school lads in Simla who are keen on this matter and to others who take it up as a recreation during a period of service there, but also to more advanced workers in their researches into the distribution of species and races.

My notes are based mainly on my own collecting and observations during occasional visits to Simla between 1911 and 1921 and during a four year period of service there later. I have, in addition, embodied all information and particulars I have gathered at various times from other collectors working in the area, and I have to thank many, and notably Brigadier Evans, for a good deal of interesting and useful information. The list should be fairly complete, especially as I have included, marked with an asterisk, all species of which I have no personal experience or first-hand knowledge but which have been recorded from the neighbourhood by various writers. A few other species, though they do not yet appear to have been taken within the limits, may reasonably be expected to occur and will possibly be discovered as time goes on. These will be mentioned and I will leave it to future workers to record their actual occurrence, if ever this is definitely established.

Before dealing with the various species themselves, it will, perhaps, be as well to give a brief description of the country to which these notes more particularly apply; and to mention some of the localities which my own experience has shown to be good *general* collecting grounds. The area covered is roughly that within a fifty mile radius of Simla and takes in the tract of mountain and valley from the spurs of the Sewaliks below Kalka to the upper reaches of the Sutlej and Giri rivers. It lies wholly within the outer ranges of the Himalayas; and situated thus, provides a great variation of altitude from the 2,000 ft. above sea level of Kalka and the valleys debouching into the plains to the 12,000 and 13,000 ft. of mountain masses like Huttoo and M'Arari and other peaks of the interior. Every description of country, except, of course, expanses of flat plains, is to be found—the broken foothills and nullahs bordering on the Dun, deep valleys like those of the Gumber and Asni and similar streams, the low basins of the Sutlej and Giri rivers, bare expanses of grass lands on the southern slopes of the numerous spurs, heavy and damp forests such as those on the inner faces of Jakko, Shali and Huttoo, and open and wind swept hill-tops ten thousand feet and more up in the air. We might, indeed, by extending the area a little further inland, get into the regions of snow in the mighty mountains and high passes just beyond the Sutlej and bordering on Kulu.

With such a range of altitude and such a variety of terrain, there is naturally a corresponding diversity of vegetation. It changes from the sub-tropical jungle of the lower foothills, past the cacti and long-leaved pines and rank grasses of the outer spurs, to the deodars and silver oaks and ilex of Simla and its environs, and on to the brown oaks and firs of the Huttoo forests and the semi-alpine flora of the inner mountains. Collet's '*Flora Simlaensis*', though written many years ago and rather severely botanical, is a mine of information on the vegetation of the District; but to the ordinary individual, interested in the trees he sees as he proceeds into the Hills or wanders about the country, I would commend a little pamphlet in which was reproduced a lecture on the subject once given by E. C. Buck to a long defunct Simla Natural History Society. I cannot say whether it is still possible to get this publication; but if so, it will be found to give a very vivid and fascinating account of the trees of the different zones.

Butterflies are to be seen in Simla practically all the year round. They are naturally not prominent in the cold winter months, but I have seen *Vanessas* and a stray *Colias* or two even in December and January with snow on the ground. Down near Kalka quite a variety are to be seen right through the cold months. They are most abundant and varied in the late spring and early summer; and, after a period of comparative thinning out

during the fogs and wet of the monsoon; they come into their own again in the gorgeous weather of the autumn weeks. There is thus always some interest for the collector; but the best months are undoubtedly May and June and from mid-September to the end of October. To get even a moderately representative series, one must be on the *qui vive* all through the weeks from the days when the first signs of spring appear till the frosts come in November and December. Quite a number of the species which are on the wing in the spring and summer do not appear at all after the monsoon has broken; and, conversely, some of the autumn species have no spring broods. Not a few kinds, moreover, have a very short period of flight—possibly not more than a fortnight or three weeks—and if not taken then, will not be seen again till the following year.

All the more common species can be seen and taken almost anywhere, and it is quite worth while spending half an hour in a sunny garden or on some open saddle on the ridges. But the earnest seeker after good things must go further afield and work for them in their own particular haunts. As a general rule, nullahs where there is a stream of running water and which are not too heavily wooded are good collecting grounds. So also are open plateaus on hill tops and some dips in the ridges and clearings through the woods which many butterflies seem to use as passages for flight from one locality to another. The grassy slopes of some of the spurs are often surprisingly rich in the sun-loving varieties. There are many such favoured spots in Simla or within easy reach and any one who does a bit of wandering with a net will soon discover several for himself. Apart from 'popular resorts', the rambler at large, moving away from highways and byways, will often come upon some patch of ground favoured by some special species, and thus, in the course of an hour or so, pick up quite a nice little group of some kind he may have been waiting for years to find.

One of the very best collecting grounds I know is the San Damiano nullah behind the Mashobra-Mahasu ridge. It is worth a periodical visit, even from Simla. There is quite a good one behind Jakko, while the little valley beyond Summer Hill, running down to the Chadwick Falls, usually teems with insect life. Some years ago, the bed of the Simla River and the stream flowing past Annandale were worth exploring, but I have not been to these in recent years. The Glen is fair, but is usually too thickly overgrown for comfort. Annandale was once a favourite collecting ground for boys, but has now, I think, become too much of a laid-out pleasure-ground to attract any but the more common species; while the Waterworks area, once an excellent butterfly locality, is now closed to the public. Other places round Simla worth an occasional visit are the grassy slopes of the spur below Bishop Cotton's School, the glades and nullahs on the Tara Devi Hill, certain stretches of the Himalayan-Tibet road between the old toll bar and Mashobra and between Mahasu and Fagu; while the country round Mahasu itself and, very especially, the plateau on the top of Kufri Hill should, under no circumstances, be neglected. Of spots further afield, I might mention some of the valleys and ravines which abound in the broken country round Kalka, the bridle path up to Kasauli, the nullahs and open hill sides between Solon Brewery and Kandaghat on the railway, the ridge along which runs the road from Simla to Chail, the road from Narkanda to Baghi and beyond, and the slopes and plateaus on Huttoo. I believe, though I have not been able to explore it myself, that good butterflies are to be found along the road to Mussoorie where it rises to Paternalla to cross the ridge leading to the Chor, and the Chor itself should give good hunting.

An energetic collector, with patience and powers of observation, who can give a little time each season to these localities and can, in addition, look over some of the higher country beyond the Sutlej and bordering on Tibet, should be able, in the course of three or four years, to get together a very representative series of the butterflies of this part of the North-west Himalayas. As will be seen from the list which follows, a complete collection would include something like two hundred and fifty species or distinct local races—a total large enough to sustain interest for a very long time. Some of these butterflies are extraordinarily rare—within the district at any rate—but there is always the hope of picking up these prizes. There is the chance, too, that species not hitherto recorded from this part of the country will be discovered either as wanderers from their own proper habitat or as having established themselves in some out of the way spot not yet explored by collectors. Would it be too much to ask of

any one who has such fortune, that he should report the find in some Society's Journal? It is only in this way that complete lists can be maintained.

In the earlier stages of butterfly nomenclature in India, many insects were either, on the one hand, given individual specific rank though almost indistinguishably near to already known and named species; or were, on the other hand, merged with other species though presenting constant minor variations. Modern science is developing the practice of differentiating groups which show constant variation as clearly defined local races of an earlier named specific type and the adoption of the trinomial system of nomenclature to denote the place within the species. Brigadier Evans, in his recent valuable work on the 'Identification of Indian Butterflies', has used this system as far as it is possible in the present state of our knowledge, and I follow him throughout.

There has been, in recent years, a change in the order in which the various families are placed. Earlier writers put the *Danaidæ* and *Nymphalidæ* first, followed by the *Lycanidæ* and then by the *Papilionidæ*, *Pieridæ* and *Hesperiidæ*. Seitz, in his *Macrolepidoptera of the World*, has brought the *Papilionidæ* and *Pieridæ* to the front of the order, and modern authorities generally adopt this arrangement. I have compiled my list accordingly.

Each species or recognized race which has been definitely recorded from the area dealt with, is given a serial number in the list. Any not actually reported but which there is a reasonable chance of finding, are mentioned without a serial number. The reference numbers in brackets (e.g. Bing. 33, de N. 272, Ev. F5(8)), are those under which the species appear in *The Fauna of India*, 'Butterflies', *The Butterflies of India*, and the *Identification of Indian Butterflies*. These will indicate to the reader where a full diagnosis and description of the insect may be found.

PAPILIONIDÆ.

As might be expected in a region where the Palearctic type predominates, the Papilios are not very prominent in the Simla Hills. Several species are to be found, but only a very few are in any sense common, and then only in the country bordering on the plains or in their more favoured haunts. Most of the species found are distinctly rare. Few as they are, however, the Papilios provide some of the largest as well as the most striking butterflies of the district.

Byasa aristolochiæ aristolochiæ. Fabricus

(Bing. 490; Ev. A 2 (10)).

This insect is very common in Southern and Continental India and appears occasionally in the Eastern and Central Punjab, but I have never come across it in the hills round Simla nor have I been able to trace a definite record of its capture. It is, however, not at all improbable that an odd specimen or two would be picked up in the country below Kalka.

1. *Byasa philoxenus philoxenus*. Gray.

(Bing. 500; Ev. A2 (15)).

2. *Byasa dasarada ravana*. Moore.

(Bing. 500; Ev. A2 (16)).

These two closely-related species are very similar in appearance and flight and, indeed, have not always been separated. They might well be dealt with together. Neither is often taken or seen in collections made in the district. I have seen butterflies which certainly were one or the other of these species on two or three occasions—always in the spring or early summer months—flying down the hill on the Simla-Mashobra road below the Retreat. They seem to have a most annoying habit of flying high out of reach.

3. *Chilasa agestor govindra*. Moore.

(Bing. 529; Ev. A3 (1)).

Is said not to be rare, but for all that, is seldom seen in collections. This is probably because it is on the wing for a short period only and then in the very

early spring weeks before people have moved up from the plains and before those who winter in Simla think it worth while bringing out their nets. A friend who was keen enough to go out at this unpromising season, told me had taken two or three each spring flying round the oak trees high up on Jakko ; and I once saw one myself in similar surroundings on Summer Hill.

4. *Chilasa clytia clytia*. Linnaeus.

(Bing. 532 ; Ev. A 3 (5)).

The *dissimilis* form of this species is found along the foot of the Himalayas, commonly as far west as the Mussoorie Dun, and very much more rarely further west. I have seen one or two specimens said to have been caught in the wooded country where the Ghaggar river emerges from the hills.

* 5. *Papilio protenor protenor*. Cramer.

(Bing. 515 ; Ev. A 4 (6)).

Has been recorded as occurring between Kashmir and Kumaon, but I have no personal knowledge of its having been taken anywhere west of Mussoorie. It is not common even there and would be still rarer to the west.

6. *Papilio polyctor polyctor*. Boisduval.

(Bing. 538 ; Ev. A 4 (9)).

This beautiful butterfly, the 'moonal' of the Simla school boy, is not uncommon in the localities it especially favours, and may sometimes even be seen in gardens in Simla. There generally seem to be a few flying about the grassy slopes of the hillsides near Salogra station on the Kalka-Simla Railway, and it was at one time fairly abundant along the toe of the Kaithu spur and in the valley between this spur and Elysium Hill. It is also fond of open nullahs where there is running water. Flies throughout the spring, summer and early autumn. Usually difficult to obtain in perfect condition as the tails break off very easily, and particularly so in the autumn when most of the specimens are badly worn.

* 7. *Papilio arcturus arius*. Rothschild.

(Bing. 541 ; Ev. A 4 (11)).

Another beauty of the insect world. Common in the spring and summer in Kashmir and the adjoining hills from 8,000 to 10,000 ft., but becoming rarer eastwards. In the Simla Hills, it will be found only in the inner hills in the Huttoo-Baghi country, though it may also occur on the Chor range.

8. *Papilio polytes romulus*. Cramer.

(Bing. 522 ; Ev. A 4 (25)).

Not uncommon in the plains and lower hills where I have seen it within a few miles of Kalka ; but it does not, as far as my experience goes, extend to any distance into the hills. The monsoon and early autumn months seem to be the best times for it.

9. *Papilio demoleus demoleus*. Linnaeus.

(Bing. 507 ; Ev. A 4 (27)).

Very common in the plains and lower hills but does not extend beyond the zone of the lime tree on which its larva feeds. I have seen specimens in the neighbourhood of Kalka, and it may perhaps go up as high as Solon ; but anything beyond this, would be most unusual. Flies spring and autumn.

10. *Papilio machaon sphyrus*. Hubner.

(Bing. 505 ; Ev. A 4 (29)).

This eastern cousin of our English 'swallow tail' is common in the spring and autumn. May be seen almost anywhere above 5,000 ft., but grassy slopes and meadows are its favourite country. It was often almost abundant on the

summit of Kufri Hill and around Narkanda. Once, as a boy very many years ago, I found this butterfly in large numbers on the lower slopes of the Kaithu spur, where its larvæ swarmed on an evil smelling shrub which is common at lower elevations in these hills.

* 11. *Pathysa eurous kashmirensis*. Rothschild.

(Bing. 548; Ev. A 5 (1)).

Recorded from 'Kashmir to Kumaon', but I have never come across it in the Simla Hills. On the analogy of its habits in the more easterly part of its range, it should be found only at low elevations near the foot of the hills.

12. *Zetides sarpedon sarpedon*. Linnæus.

(Bing. 557; Ev. A 6 (2)).

Not particularly common anywhere in the area, but may be seen occasionally from about 7,000 ft. downwards in the summer and early autumn. Is attracted by flowers round which I have taken nearly all my specimens here and elsewhere.

13. *Zetides cloanthus*. Westwood.

(Bing. 556; Ev. A 6 (1)).

Not uncommon, but needs looking for. This butterfly has a most exasperating habit of flying round some favourite tree—often an isolated one—out of reach of the net. It is consequently not generally easy to capture. I remember one particular tree on the top of Kufri Hill where it was almost a certain find. I have also taken it on Jakko and on the Kaithu spur in exactly similar circumstances. Sometimes frequents the beds of hill streams where it settles on patches of damp sand. Flies June to October and even November. It does not, in the Western Himalayas, go much below 5,000 ft.

* 14. *Parnassius jacquemontii jacquemontii*. Boisduval.

(Bing. 561; Ev. A 13 (2)).

* 15. *Parnassius epaphus epaphus*. Oberthur.

(Bing. 562; Ev. A 13 (3)).

Both of these 'Apollos' are essentially Alpine insects. They are to be found from Kashmir to Kumaon, but not below 11,000 to 12,000 ft., and would therefore be confined to the higher ranges of the interior. I have not taken either myself within the district, but it is possible that they may sometimes fly on Huttoo and other peaks.

16. *Parnassius hardwickei hardwickei*. Gray.

(Bing. 543; Ev. A 13 (4)).

The only species of the genus which, in the Himalayas, comes down to comparatively low elevations. It may be taken even in Simla, where I have seen it more than once within the station, the slopes near Sanjoui generally harbouring one or two. To find it at all commonly we must, however, go further inland. The plateau on Kufri Hill, Narkanda and Huttoo will almost invariably produce specimens. Is on the wing both in the spring and early summer and in the autumn; and, since it is a butterfly of the snows, it will probably be found in the winter months. I have taken it late in November at any rate. It affects open slopes and meadows where there is grass and alpine vegetation.

PIERIDÆ.

Several of the species are so abundant in individuals, that the Pieridæ, in contrast to the Papilioes, are always a good deal in evidence among the butterflies of the Simla Hills. They do not, as a general rule, like heavily wooded country, but in more open surroundings, they will be found abroad everywhere in gardens, in the meadows and about the grass slopes; along the nullahs and

in and out of the scrub. Some of the different species of each genus are so alike that it is usually advisable to catch and examine even the most ordinary looking individuals at any rate till some sort of familiarity with their respective little ways has been attained.

Baltia butleri butleri. Moore.

(Bing. 583; Ev. B 2 (2)).

Included on the strength of having been recorded 'from Kashmir to Kumaon', but I doubt whether it will be found anywhere nearer than the Tibet border.

Synchlœ ausonia daphalis. Moore.

(Bing. 602.; Ev. B 3 (3)).

Also recorded from the North-West Himalayas, but I have not met it anywhere nearer than the extreme north of the Punjab. It may perhaps be found straggling into the edge of our limits in the interior.

Pieris caldice kalora. Moore.

(Bing. 600; Ev. B 4 (2)).

Another higher Alpine species which, from its recorded distribution, might possibly be found on the lofty ranges beyond the Sutlej.

17. *Pieris napi ajaka*. Moore.

(Bing. 594; Ev. B 4 (7)).

Fairly common though not so abundant as the other two 'whites', *brassicæ* and *canidia*. These others are so common and ubiquitous that any insect of similar general appearance is often passed by casually and the local race of *napi* thus escapes notice.

18. *Pieris canidia canidia*. Sparrman.

(Bing. 593; Ev. B 4 (10)).

The 'small cabbage' is common everywhere throughout the spring, summer and autumn, but appears to be most plentiful after the monsoon.

19. *Pieris brassicæ*. Linnæus.

(Bing. 590. Ev. B 4 (11)).

This insect, the almost cosmopolitan 'large cabbage', is abundant from early spring to late autumn. Occasional specimens may even be seen sometimes on sunny days in the depth of winter.

20. *Aporia leucodice soracte*. Moore.

(Bing. 584; Ev. B 5 (1)).

Exceedingly common in May and June, but disappears entirely with the arrival of the monsoon and there is no autumn brood. It is particularly fond of the common wild barberry bushes round which it swarms.

* 21. *Aporia nabellica nabellica*. Boisduval.

(Bing. 586; Ev. B 5 (2)).

Has a range from Kashmir to Kumaon, and though I have never taken it myself, there is little doubt that it will be found in the Huttoo neighbourhood. Is rare at the best of times, and does not come below 8,000 ft. Usually a spring butterfly.

22. *Aporia agathon phryxæ*. Boisduval.

(Bing. 587; Ev. B 5 (4)).

May be seen very occasionally in Simla itself, but is not plentiful anywhere in the district. All the few specimens I have taken in the area were found on the northern slopes of Kufri Hill on the road to Fagu. It seems to be on the wing only for a short period just before the rains.

Delias eucharis. Drury.

(Bing 571; Ev. B 6 (2)).

Very common from Garhwal eastwards, and I have taken it in Dehra Dun and seen one as far to the north-west as Lahore. It is not unlikely to be found, though rarely, in the strip of country between Kalka and the Sewalikhs.

23. *Delias sanaca sanaca*. Moore.*Delias belladonna belladonna*. Fabricius.

(Bing. 577; Ev. B 6 (4) and (5)).

I put these together as they are usually treated as one species. *Belladonna* is fairly common, and in May and June may often be seen round the blossoms of the horse chestnut which attract them irresistibly. A few specimens may also be taken later in September and October. *Sanaca*, which was considered a light coloured variety of the species, is much less frequently seen, but I took one or two on Kufri Hill in June. Both extend inland as far as Baghi and Kulu.

24. *Belenois mesentina mesentina*. Cramer.

(Bing. 581; Ev. B 8).

Very common in the plains and at low elevations in the outer hills throughout the year, especially in scrub jungle. Rather rare above 5,000 ft., but odd specimens may be picked up now and again.

25. *Huphina nerissa phryne*. Fabricius.

(Bing. 604; Ev. B 9 (2)).

More a plains than a hill insect. It is common during and after the rains at the foot of the hills. Occasional specimens find their way up as high as 8,500 ft., and I have taken it in Simla and Kufri.

26. *Catopsilia crocale*. Cramer.

(Bing. 622; Ev. B 11 (1)).

Abundant in the plains, and, though never as common as the next species, is generally to be seen in fair numbers in the hills up to about 8,000 ft. Mainly an autumn flying insect.

27. *Catopsilia pomona*. Fabricius.

(Bing. 622; Ev. B 11 (2)).

Usually sunk to the last species, but has now been definitely placed as distinct. Flies from May or June till late autumn, more abundantly after the monsoon. Has the same general distribution as *crocale* but is always more common. Females of the form, '*catilla*'—Cramer, with purple blotches on the undersides of the wings, are almost as frequent as the type.

28. *Catopsilia pyranthe*. Linnæus.

(Bing. 623; Ev. B 11 (4)).

Like the others of the genus, is more common in the plains and country round Kalka; but it extends up the river valleys and sparingly as far as Simla and Mashobra. Is best looked for in open grass and scrub country.

* 29. *Catopsilia florella gnoma*. Fabricius.

(Bing. 624; Ev. B 11 (5)).

Recorded from the 'North-west Himalayas', but I have never seen it anywhere in North-west India, the nearest locality known to me being Lucknow. May yet be found in the Simla Hills.

30. *Gonepteryx rhamni nepalensis*. Doubleday.

(Bing. 624 ; Ev. B 14 (1)).

The Indian 'Brimstone' is common in the spring and autumn, much less so in the intervening monsoon months. Found anywhere and everywhere above about 5,000 ft.

31. *Gonepteryx aspasia zanka*. Moore.

(Bing. 629 ; Ev. B14 (3)).

Confined to higher elevations—above 7,000 ft.—and rather local though never scarce in the particular places it affects. I have taken it from June to October in various spots in Mashobra, Mahasu, Kufri and Narkanda. It is worth noting that I have often found that a *Cyaniris vardhana* area is also a *G. zanka* haunt.

32. *Terias libythea*. Fabricius.

(Bing. 640 ; Ev. B 15 (1)).

Probably the most common of this group of common butterflies. Found everywhere—but most plentifully in open grass country—from the plains up to at least 10,000 ft. and from early spring to late autumn.

33. *Terias venata venata*. Moore.

(Bing. 639 ; Ev. B 15 (2)).

Not nearly so common as the last, but is probably usually overlooked among the many *Terias* to be seen.

34. *Terias laeta*. Boisduval.

(Bing. 641 ; Ev. B 15 (3)).

Almost as abundant as *libythea*. It flies at the same seasons and in the same kind of country and is generally very common about the low hills above Kalka in the summer.

35. *Terias hecabe*. Linnæus.

(Bing. 643 ; Ev. B 15 (5)).

This species is so ubiquitous throughout India and so common everywhere that its various geographical races seem to merge into one another almost imperceptibly and it is by no means easy to differentiate between them. The race '*fimbriata*'—Wallace, which has been assigned to North-west India, is ordinarily indistinguishable from the '*simulata*'—Moore, of continental India. One or the other will be found occurring commonly throughout the range of the district at almost any time of the year. It is more abundant in the autumn than in the earlier months.

* 36. *Collas ladakensis*. Felder.

(Bing. 631 ; Ev. B 16 (5)).

Recorded from Kashmir to Kumaon, but is a rare insect of the higher mountains. If found in the district, will be only on the lofty ranges of the interior.

37. *Collas hyale hyale*. Linnæus.

(Bing. 630 ; Ev. B 16 (7)).

This species and its variety *erate*,—*Esperance* and its female form *pallida*,—*Staudinger*, though not abundant, will be found fairly regularly anywhere above 7,000 ft. To get a really good series, one must exploit the open grass slopes of the higher hills, such as the plateau on Kufri Hill and the meadows round Narkanda and Baghi. Found from May to November and occasionally in the winter months.

38. *Collas croceus edusina*. Butler.

(Bing. 638; Ev. B 16 (11)).

No one who has given the butterflies even a passing glance can have failed to notice this brilliant little orange insect about the hillsides and amongst the wayside flowers of Simla. It is the only 'clouded yellow' which extends into the plains; and it is common in the lower country in the winter months and in the hills all the year round.

39. *Ixias marianne marianne*. Cramer.

(Bing. 608; Ev. B 17 (1)).

Common on the plains and in the submontane tracts, rarer above 3,000 ft. A specimen or two may be picked up any day after the rains in the open grass lands around Simla. The bare spurs beyond Sanjouli and Mashobra are the most likely places.

40. *Ixias pyrene satadra*. Moore.

(Bing. 606; Ev. B 17 (2)).

Not uncommon in the plains and lower valleys to about 3,000 ft., but rarer in the inner hills. I have seen it in the Asni river valley and Col. Chaldecott took several near Luri on the Sutlej below Narkanda. Season as for *marianne*.

*41. *Colotis amata amata*. Fabricius.

(Bing. 648; Ev. B 18 (1)).

This species is fairly common in the central Punjab plains and one is said to have been taken near Ambala. There is just a chance that an odd one or two may be picked up below Kalka.

41. *Colotis etrida etrida*. Boisduval.

(Bing. 654; Ev. B 18 (5)).

Is also a species of the drier plains, but extends very sparingly into the fringes of our area at the foot of the hills.

Pareronia valeria hippia. Fabricius.

(Bing. 659; Ev. B 20 (3)).

I know of no record of this insect west of Dehra Dun, but it is not uncommon there, and there seems to be no reason why it should not occur in the similar country westwards along the foothills into the Kalka area. It will be rare but should certainly be looked for.

DANAIDÆ.

Though the Danais group of butterflies usually figure so prominently in Indian collections, none of the species of the family can be said to be really common in the Simla Hills. They are essentially insects of the plains and warm valleys, and though some of the species are fairly common at the lower levels of the hills in the north west, even these, as a general rule, become scarcer as one ascends into the mountains. Only some eight species come into the district at all.

42. *Danais aglea melanoides*. Moore.

(Bing. 15; deN. 16; Ev. C 2 (1)).

We are almost at the extreme westerly limit of the range of this insect, and it is very rare here. It will occasionally be found along the foot of the hills, but does not go above 2,500 ft. I once got a very worn specimen in a nullah near Kalka in May.

43. *Danaïs tytia sita*. Kollar.

(Bing. 14 ; deN. 20 ; Ev. C 2 (5)).

Not very common but may be seen at intervals—oftener in the autumn than in the spring. Usually flies high in and around Simla, where I have taken it in June, September and October ; but is more abundant and more easily taken in the valleys of hill rivers.

44. *Danaïs limniace mutina*. Fruhstorfer.

(Bing. 12 ; deN. 26 ; Ev. C 2 (9)).

Very common in the plains and comparatively so in the country round Kalka, but seldom seen above 4,000 or 5,000 ft. Taken in the bed of the Simla river in September, and below Summer Hill in June.

45. *Danaïs melissa septentrionis*. Butler.

(Bing. 13 ; deN. 27 ; Ev. C 2 (10)).

This species shares with *D. tytia* a preference for the hills as distinct from the plains and is not likely, in the N. W. Himalayas, to be found below 4,000 ft., though its eastern and southern races descend almost to plains level. Any hyaline *Danaïs* taken round or beyond Simla is almost certain to be either this species or *tytia*. Usually found in open nullahs, but sometimes flies in the station and in grass country. Occurs both spring and autumn.

46. *Danaïs plexippus*. Linnæus.

(Bing. 6 ; deN. 31 ; Ev. C 2 (12)).

47. *Danaïs chrysippus*. Linnæus.

(Bing. 8 ; deN. 28 ; Ev. C 2 (14)).

Might conveniently be dealt with together. Both are common in the plains and in the low river valleys, less so at any elevation in the hills. *D. chrysippus* is generally the more abundant in the plains, but seldom goes very far into the hills ; while *plexippus* travels further afield and may not infrequently be seen in and around Simla, though I have not met it above 8,000 ft. Both prefer open surroundings and fly from April to October, but are more in evidence after the rains.

48. *Euplœa core core*. Cramer.*Euplœa core vermiculata*. Butler.

(Bing. 31 ; deN. 61, 62 ; Ev. C 3 (15)).

Two local races of the typical *core*, distinguished only by the appearance of the white post discal spots on the forewings, which, in the former, tend to decrease in size towards the apex, and, in the latter, increase in size. Typical *core* is said to be the continental and plains form, while *vermiculata* is the Himalayan variety. Though, in a long series of insects, this distinction is abundantly clear, I have not been able to satisfy myself that either form is restricted to any particular area. Both may be taken within the country dealt with in this paper, *vermiculata* being very much the scarcer form. Taking them together, they are common in the plains and near Kalka, but markedly less so as one proceeds higher and are rare above 4,000 ft. A very occasional specimen may be seen in Simla in the summer and autumn.

* 49. *Euplœa mulciber mulciber*. Cramer.

(Bing. 46 ; deN. 56 ; Ev. C 3 (1)).

deNiceville has recorded this species from 'near Kalka,' and this is the extreme westerly limit of its range. Though so common in the Eastern and Central Himalayan foothills, it is rare even in the Mussoorie Dun, and its appearance here is very exceptional. Any that there are, would be found in the low valleys and ravines near Kalka.

(To be continued)

OBITUARY

JOHN C. ANDERSON

On the 17th June, 1930, John Coussmaker Anderson passed away at Ramsgate, aged 78, and there must be many old friends who remember him, although he left Bombay so long ago as 1901.

He was the son of General William Coussmaker Anderson and Caroline Cahill, and was born at Dharwar, Bombay Presidency, on 9th September, 1851. He was educated at Rugby and afterwards read at the Inner Temple, being called to the 'Bar in 1875. Three years later he went out to India and practised in the High Court at Bombay for 25 years. He married on his retirement from India in 1901. When he returned to England he made his home for ten years at Winchelsea, Sussex, where he was Mayor for a time, but in 1915 he moved to Ramsgate on account of his health.

J. C. Anderson was one of the eight original founders of the Bombay Natural History Society and as another old member writes, 'he was a keen lover of nature and helped the Society in many ways, years ago'.

In January 1889 he contributed an interesting Paper to the Journal (No. 1, Vol. IV) entitled 'Sporting Rambles round about Simla', and presented to the Museum a large number of specimens of skins of birds and mammals collected by him round Simla.

He leaves a widow, three sons and three daughters to mourn their loss.

Although handicapped by bad health in his retirement, he devoted a great deal of his spare time to painting and derived much pleasure from this hobby.

A very lovable man, whose loss will be regretted by all those who were privileged to know him and their sympathy will be with his widow and family in their great bereavement.

W. S. M.

November, 1930.

REVIEWS.

I. THE GAME-BIRDS OF INDIA, BURMA AND CEYLON, (PHEASANTS AND BUSTARD-QUAIL) VOL. III.—By E. C. Stuart Baker, O.B.E., F.L.S., F.Z.S., M.B.O.U., H.E.A.O.U., with 11 coloured plates and 9 black and white plates. 340 pp., John Bale, Sons & Danielsson, Ltd., London, 1930. Published by the Bombay Natural History Society.

During 1915 to 1919 Mr. Stuart Baker published in the *Journal* a continuation of his articles on the game birds of India and these have been brought up to date and are now published in book form.

This volume—number three of the series—includes the Hemipodes or Bustard-Quails—the Megapodes and the Pheasants, and will be of great interest to all sportsmen and naturalists in the East.

The first family treated is the *Turnicidae* or Button-Quails, which includes three species, the Bustard-Quail, the Little Button-Quail and the Button-Quail.

Apart from certain anatomical differences, these little birds have a common habit in which they differ from all of the game birds in that the males incubate the eggs and bring up the young without the help of the female.

Of the Bustard-Quails no less than seven races are now recognized, while in his articles in the *Journal*, Mr. Baker only gave two. This increase in the number of recognized races is due to a careful revision of the group in conjunction with the late Mr. H. C. Robinson.

The colour differences which distinguish these races were many years ago pointed out by Mr. W. R. Ogilvie Grant, who attributed them to the variation in the rainfall in the different localities, but probably that is only one of the many causes.

The Little Button-Quail, Mr. Baker considers a good species, but we are rather in favour of Dr. Stressman's view that it is a race of the common Hemipode of Europe *Tarmix sylvatica*, of which there are various races in Africa.

Of the Large Button-Quail two races are allowed as before, but unfortunately there has been an inevitable change of name and the Burmese subspecies is now known as *Turnix maculatus maculatus*, instead of *Turnix tanki blanfordi*.

The next birds to come under review are the Megapodes of which we have two races, the one in the Andamans and the other in the Nicobars. Here again we have birds with very different habits from either the game birds or the Hemipodes, and instead of incubating their eggs, they deposit them in prepared mounds of dead leaves where they are hatched by the heat given off by the decaying vegetation. The young when hatched can fly, and apparently the parents take no interest in them.

Since the account of the Peacock-Pheasants appeared in the *Journal*, these birds have been revised by Dr. P. R. Lowe, who found that a hitherto unrecognized race inhabited the area between Sikkim and Manipur. The display of the Argus Pheasant is well illustrated by a photograph taken in the London Zoological gardens by Mr. Seth Smith, but there is no mention in the description that the male watches the female through the angle formed by the wing,—a fact which was first demonstrated by Mr. Seth Smith.

The account of the habits of the Red Jungle-Fowl by Mr. Baker and of the Grey by Davison are very complete and make interesting comparison. We now come to the pheasants but the only true pheasant found within our limits is *Phasianus elegans*, Stone's Pheasant, though Mrs. Hume's Pheasant and its Burmese race are very closely allied, but are now kept in a different genus *Syrmaticus*, on account of the feathers on the rump being short and rounded instead of long and disintegrated, and there are certain other small but constant differences. These birds are confined to the Eastern portions of our region.

The account of the Cheer and Koklas Pheasants will be of more general interest since, with the exception of Mayer's Koklas, they all inhabit the

Himalayas, but why the last is included we do not quite understand since the distribution given 'Yerkalo, Upper Mekong to Central Tibet' can hardly be said to be within our area.

The beautiful Amherst Pheasant has occurred in the Myitkyina District but it is strictly speaking a Chinese bird, while the Fire-back, called Vieillot's Fire-back Pheasant, in the *Fauna*, is found in the extreme south of Siam, and the Siam Fire-back Pheasant just comes into our limits in the South Shan States.

From the Indus to China and as far south as Tenasserim and Indo-China there is found a heterogeneous collection of pheasants belonging to the genus *Gennæus*, which are known as Kalij or Silver Pheasants. These birds in certain areas, the Himalayas, Assam, China, Indo-China are separable into several species and numerous races, that is to say in certain districts the pheasants are all of one type. In certain parts of Burma, however, there is a very different state of affairs, and except in Arrakan and Tenasserim, there are really no distinct types but all manner of mongrels. In the British Museum, there is probably the largest collection of these pheasants anywhere, but it is totally inadequate to solve the problem of the Silver Pheasant in Burma. Residents in that country could do much towards clearing up the question of the Silver Pheasant if they would carefully collect specimens with full particulars as to the common type in their district and whether the different types consort and breed together. Mr. Baker, we think, has made the best of a bad job with the existing material and considers the Kalij and Silver Pheasants to belong to six species, though he cautiously suggests in his definition of the genus *Gennæus*, that perhaps ultimately we may have to consider them all belonging to one species with numerous sub-species.

There are few birds more beautiful in colour than a male Impeyan Pheasant or Monal, and we are glad to learn it is still common in the Himalayas. In the past large numbers were killed for their skins and we have seen boxfuls confiscated by the Customs. According to Mr. C. H. Donald, the trapping of this bird still goes on and we suppose some consignments evade the Customs and reach some Continental market, but we are certain very few are now smuggled into London, and doubt very much if London dealers have anything to do with the trade as Mr. Baker rather suggests.

We can strongly recommend the volume to members, and considering the wealth of illustrations, it is cheap as bird books go nowadays.

Mr. Grouvold and the printers are to be congratulated on their share of the work.

N. B. K.

II. THE FORMENKREIS THEORY AND THE PROGRESS OF THE ORGANIC WORLD.—By Dr. Otto Kleinschmidt. Translated from the German by the Rev. F. C. R. Jourdain, M.A., M.B.O.U., F.Z.S. 192 pp.; with 16 plates from photographs and numerous text-figures. London (H. F. & G. Witherby). Price 10s. 6d.

In this book (originally published in German in 1926) the author who is a clergyman as well as eminent German ornithologist, attempts to show that the old Theory of Evolution is all wrong. He claims that his own theory, which he here offers instead, and which according to him is essentially a 'recasting of the old Evolution Theory', upholds 'the indications found in nature as to independent sources of life in opposition to the theory of a common origin for all life'. He contends that the evidences hitherto cited in support of the theory of descent of all life from the protozoon—Palæontologic, Embryologic, by Blood serum tests and others—are entirely misleading. Among other things he denies the possibility of birds having been derived from reptilian stock, and gives his reasons for discrediting the belief that the Archaeopteryx was the probable ancestor of our present day birds. He maintains that in the theory of Recapitulation the seeming phylogenetic resemblances in embryos has been grossly exaggerated. He asserts that species cannot be derived from races, and in short, the existence of so many different forms of animal life on the earth seems to him accountable only on the assumption of there having been so many independent creations.

The author explains at the outset that the idea of Formenkreises or 'Form circles' is no innovation of his; it was first suggested by the celebrated philo-

sopher Kant as early as 1775. Indeed the term 'Formenkreis' itself is not new to zoologists either, but it has hitherto been employed—principally in Entomology and Malacology—in a slightly different sense to that now assigned to it by Dr. Kleinschmidt. The former used it merely to denote a group of geographical forms or races and as such therefore it may be considered synonymous with what is more commonly known to us to-day by the term 'Species'—a unit capable of being split into a number of geographical races or sub-species, or conversely, comprising all such. To take an example near home, our Indian House Sparrows *Passer domesticus indicus*, *P.d. nigricollis* and *P.d. parkini* are all treated by us as belonging to the same Species, or in the sense of the term as used before Dr. Kleinschmidt's resuscitation of it, they would all be considered geographical forms of the Formenkreis *Passer domesticus*. Between the term as used above and the significance now attached to it by Dr. Kleinschmidt there is an intrinsic difference. Dr. Kleinschmidt does not only lump geographical *races* under this term, but all forms which he considers to be geographical *representatives* of one another, even where these have been differentiated as Species from Miocene times! He widens the limits of each allied group 'of independent origin' to 'an inconceivable extent'; in other words his 'Formenkreises' include much more than mere geographical races.

The author lays stress on the fact that for different forms to belong to a single Formenkreis two essential conditions must be satisfied, viz.: (1) the forms must exclude each other geographically, and (2) they must replace each other. These seem to us to be more or less the identical conditions required for what are known to us as Geographical Races! In order to make his meaning clearer the author explains: 'A Herring and a Zebra exclude each other geographically. The last lives on the African Continent, the former in the North Sea' (p. 34), and since the Zebra does not replace the Herring as the various species of Herrings do each other, the Zebra and the Herring belong to two different Formenkreises. Well and good. But among the carefully selected examples of Formenkreises which are given (the truth of some of which, as for instance the Marsh and Willow Tits among birds, has already been accepted by systematists) when the assertion is made that *Passer domesticus* and *P. hispaniolensis* belong to the same Formenkreis in spite of the fact that in many areas the two species ('forms' according to the author) are found breeding side by side thereby distinctly contravening one of the fundamentals above stated (viz., 'Formenkreises can exist side by side, races exclude each other geographically'), we fear the author's explanation for this discrepancy will not be generally accepted.

According to the Formenkreis Theory it seems it is not necessary for the geographical replacement to be able to show all its existing connecting links, and there may be extensive gaps in the distribution of two apparently quite different forms which may nevertheless belong to one and the same Formenkreis. To make the author's implication, as we understand it, clearer, we shall take a hypothetical case. Readers will recall the interesting paper which recently appeared in this Journal (vol. xxxiv, pp. 754-71) on the Origin of Continents and Oceans according to Wegener's Displacement Theory. Well, suppose the Formenkreis of a certain bird existed over Brazil and West Africa at a time when the two continents were united along their edges. When the land masses drifted apart, their fauna was also naturally split up, but in spite of this one would expect to find birds in Brazil and West Africa to-day belonging to the same Formenkreis, though having been separated for such a lengthy period, the two forms may now have become quite unrecognizable as such. They may perhaps even be classified by our systematists under totally different genera, whereas a careful examination of their skeletal characters and natural affinities, it is claimed, would show them as belonging to the same Formenkreis! The Seal of Lake Baikal is cited as an example more or less of this nature, its presence there being only accountable by the fact that Lake Baikal was formerly connected with the northern oceans by an unbroken stretch of sea. Both the seals, though widely separated and living in areas not at present subjacent to one another, apparently belong to the same Formenkreis. The Seals of the Caspian could, we imagine, also be cited as an example of this kind.

We rather think that the author has contradicted himself in this interesting suggestion. If he can conceive (as we gather) that isolation and milieu may bring about changes in an organism of the magnitude suggested in our hypothetical case (viz., to render classification into a totally different species or even

genus necessary) why will he not allow us to conceive that under given conditions Species may develop from Races and from one another, or—to carry the thing to its logical conclusion—that all beings may have evolved from a common origin? The author, however, definitely seeks to prove throughout his work that Species have not been derived from Races and from one another as is commonly believed to-day, but must be the result of so many original creations! Unfortunately many of his arguments seem to us rather far-fetched and not altogether convincing, and we must confess that in the present state of our knowledge his stand appears to us only justifiable by the fact of his being—in spite of his scientific outlook and attainments—essentially a theologian of the old school.

In the course of his book, Dr. Kleinschmidt suggests a new system of trinomial nomenclature based on a recognition of Formenkreises as defined by him. We can only hope that he is not in earnest as, in our opinion, its adoption at this stage can only lead to making confusion more confounded than ever!

On the whole, Dr. Kleinschmidt's book is interesting reading and furnishes a wealth of arresting and thought-provoking material which the author has laboriously collected in the course of the last twenty-seven years during which he has been engaged in elucidating his theory. Though we may not be able to see eye to eye with him in all that he has to say, we cannot but admire the learning and industry which have enabled him to formulate his theory, and his courage in exposing it to the almost certain hostile fire of what he considers sceptical and biased people.

Dr. Kleinschmidt's style is unfortunate. In places it is unnecessarily pompous and dogmatic and extremely difficult to follow unless read and re-read over and over again. On laying down the book one is left with a lurking suspicion that there may really be more in his theory than has caught the eye. Clarity has not been enhanced by the translator's effort to 'reproduce in English the exact words of the author, not amending or altering the text in any way, but preserving as far as possible the characteristics of the writer' (p. 15), although in fairness to the translator we must confess it would have been extremely difficult to render a work of this nature faithfully in any other manner.

S. A. A.

III. AN INTRODUCTION TO ZOOLOGY.—By P. W. Gideon with illustrations. 88 pp. Student's Own Book Depot, Dharwar, 1930.

Prof. Gideon's Introduction to Zoology is a publication primarily intended for the use of the Intermediate Science Examination students of the Bombay University, who study a few types of animals representative of some of the principal phyla in Zoology. He has prepared the book with this intention and incidentally tried to condense in it as much information as possible about systematic Zoology in connection with those phyla in the form of charts or tables. He has succeeded well in accomplishing his first object, inasmuch as facts relating to the type-animals are given in a most terse manner which the students will find easy to follow. But beyond this there is nothing special or original in the treatment of the subject to attract attention, nor is any new piece of information of an original kind embodied therewith.

In the fulfilment of his second object of imparting knowledge about zoological classification it may be said that he has fallen short of it. Without brief and proper explanatory discussion on the classification of the phylum given in each chart as a preface to it, the chart by itself will not appeal to the student and the students are very likely to overlook these charts. The book is thus one more addition to the host of such elementary publications. However, on the whole the book has been most carefully prepared. The illustrations are all well drawn and executed, but they all appear to be familiar figures from various standard books.

Moreover, at page 3, the author gives the chemical composition of proteins as formed of C. H. N. & O. only which is not proper. No protein compound exists without traces of S. being present in addition to the above elements. No hints for the practical work are given which is rather unfortunate.

27th October, 1930.

V. N. H.

AN OPEN LETTER TO THE EDITORS

A perusal of several recent articles in the *Journal* has induced me to write on a matter of considerable importance to the study of Ornithology. We are face to face with a danger which has arisen in most countries but at the moment is particularly evident in India. I refer to the indiscriminate use of subspecific or racial names.

It is easy to see how this danger has come upon us. The progress of Indian Ornithology has hitherto been one of fits and starts, of periods dominated by the work of outstanding authorities; each of whom in turn gave an impetus to the study and finally became, through no fault of his own, something of a stumbling block. Jerdon, Hume and Blanford and Oates each in turn summed up the Ornithological work done in India and each in turn retarded it as their writings grew out of date and yet retained the confidence of a circle of field naturalists working in a land far from the centres of scientific thought.

When I arrived in India and started to work on Indian birds, my constant guide, companion and friend was found within the covers of the four volumes of Blanford and Oates, which we now term the *Old Fauna*. My case was the same as dozens of others. We turned to the *Fauna* for each new bird that we met with. We accepted its dicta with complete and justified confidence. We catalogued and inscribed our eggs and skins with the serial number of the species in the *Fauna*. We corresponded with each other according to the names and numbers of the *Fauna*. Occasionally with triumph we hailed a small discovery of some fact which was 'not in the *Fauna*' and we immediately wrote to the *Journal* about it. The result was that we in India attained for a time the millennium of all good Zoologists—uniformity of Nomenclature.

Then we gradually awoke like Rip Van Winkle. We found that the world had passed us by. We were writing and talking a language that to the rest of the Zoological world was becoming archaic. There were people who smiled at us when we wrote to them about No. 1 *Corvus corax* and they said that they supposed we must mean *Corvus corax laurencei*; or was it *Corvus corax tibetanus* to which we referred? We answered loftily about the views of the *Fauna*, and they were quite unimpressed and capped us with Hartert.

Looking back now I remember my own struggles against this clumsy unsatisfactory new system of trinomials, new to me at a time when science in Europe had entirely accepted it; and chief of my arguments was that it could not be made to square with my bible, my *Fauna*. It is amongst the many debts which I owe to the present Editor of the *Ibis* that he patiently struggled with my doubts and hesitations and at length led me to understand the virtues of the new system. I accepted it at last and painfully annotated my *Fauna* with the aid of Hartert's great work, endeavouring to reconcile the old and the new. Looking back through the past volumes of

the *Journal* I see that I was the first to introduce a trinomial into the serried ranks of *Fauna* names and *Fauna* numbers : and naturally enough I was attacked for helping to upset the good *Old Fauna* names.

However that is all past history. The present is with us and that includes a *New Fauna* complete with trinomials. Now the point of my letter appears. An ornithological public in India is proceeding to treat the *New Fauna* as they treated the old. It is to provide a standard catalogue into which all the birds of India are to fall in neat compartments, ticketed and docketed and filed with the precision of a Government office. If ornithological science in India is to prosper, this tendency requires to be stopped at once and the author of the *New Fauna* would be the first to agree with this.

It is necessary first of all to explain the reason why there should be such a difference between the treatment of the *New* and the *Old Fauna*. And then I will show the harm that will result if the difference is not recognized.

Now the unit of treatment in the two *Faunas* is different. In the *Old Fauna* it is the species, in the *new* the subspecies. The species is a unit about which there is on the whole very little doubt. There are exceptions of course but on the whole there is very little difficulty to a moderately competent ornithologist over the recognition of species from a book. In the *Old Fauna* a keen, working ornithologist could probably recognize 90 per cent of the species from the written descriptions. Recognizing species alone, the *Old Fauna* disregarded minor distinctions. Under No. 1 *Corvus corax*, Oates grouped (with slight heart-searchings no doubt which often led him to comment on the points) the largest race of the Raven, the fine bird of Tibet, with one of the duller smaller races of the desert. It was not difficult for the egg-collector who knew his Indian birds fairly well to settle on the balance of knowledge and description and probability that the nest he had found belonged to a Raven. And this division held good whether he found his nest in Tibet, in the Punjab or some obscure outlying region of the North-West Frontier. It was a Raven's egg and that was all he wanted to know. A higher authority had settled that although Ravens in these areas might differ *inter se* the point could be disregarded.

In similar cases the difference might be larger and then the authority decided that the point was to be recognized and a second species was duly chronicled : but here again it was fairly safe on the balance of descriptions and possibilities to fit the bird or its egg into its appropriate division. In due course the keen student wrote his paper for the *Journal* on the birds of his district and it was fairly safe for the reader and collator to assume that 90 per cent of the birds were named with their appropriate names. The divisions were wide enough to give a high margin of safety.

With the *New Fauna* all this has changed. The unit is the subspecies and the subspecies is a far narrower compartment or pigeon-hole into which to fit one's observations. Take the case of the Common Grey Tit of India for instance. In the *Old Fauna* we were provided with one species which we called *Parus atriceps*. It was easy to recognize in the cabinet and in the field. There was

nothing like it in India. Seen in Kashmir or the Nilgiris it was immediately recognizable—beyond all doubt if the view was clear and the observer competent—and immediately one's notes could be placed confidently in their appropriate division without a care for minor differences which our *Fauna* had stated, were negligible.

Now it is far different. The *New Fauna* has given 5 sub-divisions of our old division, for India proper alone. For each of those sub-divisions, that is races, it has given a diagnosis and a distribution. The Indian Ornithologist is immediately proceeding to behave in the face of these five races as he behaved with the old *Parus atriceps*. He is a little bothered by the fact that he has five pigeon-holes instead of one and reading the differences between the races he finds them hard to visualize and perhaps to fit in with his actual specimens. But he duly decides (with an eye on the distribution) that his bird is probably of such and such a race and in due course proceeds to chronicle it as such. The result is that in many of the recent numbers of the *Journal* many racial identifications appear which are certainly wrong and far more that are probably so.

If this continues, there will be only two possible results, for papers are set on record as contributions and aids to future work. The next writer who proceeds to use these papers as a basis for further writings and collations, will, if he is unwary, accept these wrong racial identifications and piling Pelion upon Ossa build up a structure which will prove entirely useless and incorrect. Or, if he is wary and has the necessary knowledge he will soon spot the number of wrong racial identifications and finally be compelled to reject almost everything, through sheer inability to sort the correct from the incorrect.

The author of the *New Fauna* is the first to acknowledge that the information in the new edition is not beyond dispute. He says himself that he regards his volumes as the starting point for fresh work, and that plenty of it remains to be done. The material is not yet available for a complete account of the birds of India to be written. The *New Fauna* has suggested *in the light of available evidence* a system of races or pigeon-holes into which Indian birds can be distributed. But we must remember that with the exception of Sind, the Punjab, the Himalayas and the Bombay Presidency, there is no part of India in which any material number of specimens have been added to the Hume collection now 70 years old. The *Old Fauna* was based on the material in the Hume collection; to-day in the British Museum workers turn over the same skins which Hume collected with little else to supplement them. The whole of the eastern side of the Madras Presidency, Mysore, the central plateau of the Deccan and Central India, and Central Bengal are still virtually unknown to us in an ornithological sense, whilst numerous smaller areas require to be worked. It is clear therefore that no arrangement of subspecies provided in the *New Fauna* can be regarded as a final arrangement.

To remedy this state of affairs the Society arranged with the generous aid of Mr. Vernay to send out the survey of the Eastern Ghats. Working out this collection with Mr. Kinnear, I have already seen how many forms require revision, both in regard to their

races and their known distribution. In the first family of the *Fauna*, the *Corvidæ*, for instance we have made two discoveries; that the Indian Tree-Pie, one of the commonest and best known of Indian birds, needs yet another race *vernayi* in addition to the race *pallida* which Mr. Stuart Baker himself has added in Vol. VII to his original treatment of the group; and that the Himalayan Tree-Pie is represented in the Eastern Ghats by a new and common race whose existence there was not even suspected by the ornithologists of to-day. Yet in both cases the authors of the recent papers whose practice I am deploring if they had been collecting in the Madras Presidency would have doubtless identified their specimens of these magpies by the trinomial names already in Vol. I of the *Fauna*. We should have then seen the absurd situation of the small pale Tree-Pie of Madras being called by the name of the large dark Bengal bird *vagabunda*; whilst the tropical, fever-ridden jungles of the Northern Circars would have been credited with an East-Himalayan race of a wider spread species. What is the use of such work and records?

There is a further point. Many geographical races differ in details which are not easily appraised from a written description. *Chloropsis aurifrons aurifrons* and *Chloropsis aurifrons davidsoni* are easily distinguished from a written description through the presence or absence of certain markings. *Emberiza cia stracheyi* and *Emberiza cia par*, on the other hand would never be safely distinguished by a field naturalist with one bird in his hand and merely the book to guide him. With both races before one, the first glance shows their distinctive paleness and darkness but comparison cannot be attained without the presence of the standard. Yet there are many other good races, and several species, which no one can claim to identify without careful comparison or great experience. In our survey series from the Eastern Ghats, common birds like the Quaker-Thrush (*Alcippe poiocephala*) and Horsfield's Scimitar-Babbler (*P. horsfieldii*) have given us endless trouble to identify even subspecifically with a large series of each obtained by the Survey and the big series in the British Museum for comparison.

There is a third cause for error, namely, the tendency of birds to migrate or wander. If we merely identify our races by guess-work, we lose the chance of learning all those details of migration and migration routes which the study of subspecies is most especially likely to furnish.

In the *Old Fauna*, *Emberiza stracheyi* was said to migrate to the plains of the N.-W. in India. When I was posted to the Jhang District some years ago I found a Bunting common there in winter and at first accepted it as being *stracheyi* come down from the Himalayas in winter, according to schedule. I collected a few specimens and took the trouble to compare them with my specimens from Simla. They were very different and hunting about in the pages of Hartert, I learnt about *E. c. par* which my birds were verified to be. Starting with this information I have since learnt how there is considerable migration of this Bunting from west to east in place of the north to south migration assumed in a day when geographical races were not recognized.

To take another instance. Some years ago I wrote an account of the migrations of the Pied Crested Cuckoo (*Clamator jacobinus*) appealing for data so that we could find out whether the myriads which appeared in Northern India in the rains wintered in the South or in Africa. The specimens procured in the Eastern Ghats survey prove to belong to the Ceylon race *laprobanus*, a point which virtually settles that our Northern migrants go to Africa.

To recapitulate briefly, the state of our knowledge renders it very unsafe to identify the race of any Indian bird by guess-work from a perusal of the *Fauna*. The fact that our knowledge of the distribution of Indian birds and their races is incomplete; the fact that races are often recognized only with skilled knowledge and comparison; the fact that on migration, birds wander into the territories of other races of the same species;—these facts all combine to render guess-work and deduction very liable to error. That being so, one must ask the question what is the value of subspecific identifications made without satisfactory reasons. There is only one answer and that is *none*. And I go further and assert that every identification of this type is worse than useless; it is definitely harmful for it not only may lead us definitely astray on matters of fact; while an accumulation of such identifications in literature will land us in a morass of error, throwing suspicion on good and bad alike, and it will take a generation or more to put our knowledge straight again.

Destructive criticism should always be accompanied by advice. So I now propose to suggest the lines on which our members should write their papers.

The ideal Scientific paper on the birds of a particular district would be one in which all specific and subspecific identifications were based on an actual examination of specimens procured in that district. It is not necessary that these specimens should all be collected by the writer *de novo*. If I set out to write a full account of the birds of the Nilgiri Hills for instance, I could base the greater part of my identifications on the fine series collected by Davison sixty years ago and available in the British Museum. I could supplement it with an examination of other specimens now in the Calcutta Museum, in the Society's collection and in many private collections. Doubtful points I could clear up by collecting a few birds myself, and the more thorough and painstaking my work and my use of existing material, the fewer birds I should need to kill for my purpose in an area which had been adequately worked in the past. On the other hand if I were stationed in some virtually unknown and unexplored area on the Burmese frontier I should need to procure specimens of almost every species, neglecting only those well-marked forms of which there could be no possible doubt of identification, assuming that I already had a good knowledge of my subject.

Between these two extremes we have to fit the circumstances of our particular district. The purpose is to know what species and race we are writing about, and as completeness is never possible, it is essential to make it clear to others what degree of completeness has been attained. This is done in various ways. Some writers list or mention the number of specimens they have been able to

examine. Others affix an asterisk to the names of all species and races of which specimens have been procured and examined. Others use a binomial in general and a trinomial where actual specimens have been identified, that is to say they do not mention the race or subspecies without definite grounds on which they have satisfied themselves as to the correctness of their sub-specific identification. The method matters not; all that is necessary is to leave as part of your record an indication of the value of your record. If you have collected no specimens in verification, say so but do not list all the subspecies by guess-work. Your paper can still be of value in other ways.

The matter of course requires to be treated with the usual leaven of common sense and appreciation of circumstances. If I were to tour through six or seven districts of the Punjab in the spring and all the way I came upon Grey Shrikes breeding I should accept them all as *Lanius excubitor lahtora* without a shot fired. My knowledge of previous identifications of this breeding shrike in this area, confirmed by the *glassing* of occasional birds to verify the presence of the black wing coverts would be sufficient. But Grey Shrikes met at this season on the frontier hills obviously on migration would require and receive a very different standard of proof before I published any trinomial identification. To assume or to guess in their case, would be a very different matter. Yet here, too, I should gradually be able to relax my standard if my posting were in some frontier fort where the careful individual identification of one year could relax with the growing familiarity of spring after spring.

And here a word of caution is necessary. One often reads that a bird was shot and identified with the *Fauna* but the specimen was not kept. Such an identification is far from settling a disputed point. Mistakes occur and often outrageous ones—I have had the skin of a 'Crested Lark' sent me to confirm a record of nest in an area where no crested lark should be; yet when the parcel arrived, it contained a Crested Bunting, perhaps the most destructive of all Indian birds and which had merely the crest in common with the lark (and fifty other birds). Shoot a Meadow Bunting across the border in Afghanistan and compare it with the *Fauna* description, yet unless you have already studied the point and know it, you will not safely identify your bird either as *par* or *stracheyi*, not safely enough that is to base some new fact or distribution upon it. So if you have shot your bird for the record, make a skin of it for future verification; if you cannot skin in the correct manner split your bird from chin to chine and pull off the skin as a flat one. If you cannot do that, cut off the wings and tail and legs and put them in an envelope. Then the record can be verified.

I hope I have made it clear that it is possible to write and write usefully on the birds of an area without killing a single bird. The measure of the value of such a paper lies in the honesty of the writer. If he makes it clear how his identifications were arrived at in general terms, and expands this into an explanation of the grounds on which he bases unusual records, it is then possible for the student of wider areas to assess the proportionate value of the records, taking the satisfactory ones and rejecting the unsafe. But

AN OPEN LETTER TO THE EDITORS

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let the student once assess the writer as untrustworthy (through lack of knowledge or want of care) and he will probably reject the paper *in toto*.

And so with the writer of short miscellaneous notes, who should use the binomial unless he has definite reason to use the trinomial. Each of us comes across interesting incidents which we wish to record, the Red-vented Bulbul's behaviour in our verandah, the unusual clutch of eggs and so forth. If we really know the subspecies to which we are referring that is all to the good and should be recorded. But if we are deducing the subspecies by the geographical position of our verandah, we had far better leave that deduction to the reader and let him be responsible for the further use he makes of it. We should set down just so much as we know, or if we deduce we should make it plain that we deduce, and then our contribution to knowledge will be exact and free from error.

And now, Sir, I must apologize to you and the readers of our *Journal* for so long a homily, but unless our members realize that the *New Fauna* has introduced a more precise type of scientific nomenclature to Indian Ornithology and that for this reason they must draw a distinction between their treatment of the *New* and *Old Fannas* we shall find ourselves in India in a hopeless muddle which will delay all further progress. It is not an imaginary evil which I am describing. The first fruits of it have already appeared in more than one recent paper which it is hardly fair to specify more exactly.

CALDBEC HOUSE,
BATTLE,
23rd January, 1931.

HUGH WHISTLER.

THE FOUNDERS OF THE BOMBAY NATURAL HISTORY SOCIETY.

It may be of interest to put on record in the *Journal* the origin and early history of the Society.

The Society was formed on the 15th September 1883 by, I believe, eight residents of Bombay whose names were :

Dr. D. MacDonald
Mr. E. H. Aitken
Col. C. Swinhoe
Mr. J. C. Anderson
Mr. J. Johnston
Dr. Atmaram Pandurang
Dr. G. A. Maconochie
Dr. Sakharam Arjun

In the proceedings of a Meeting of the Society held on the 22nd April 1902, (Vol. XIV, page 408), the late Mr. Aitken in referring to the approaching retirement of Dr. D. MacDonald, said, 'probably few of those present knew the real origin of the Bombay Natural History Society, or had any idea that Dr. MacDonald was the *fons et origo* of the whole thing. But such was the fact. It was early in 1883 that Dr. MacDonald suggested that it would be an excellent thing to form a Society for the study of Natural History.'

Mr. Aitken then mentions that six gentlemen met in the Victoria and Albert Museum and constituted themselves the Bombay Natural History Society. The six names he mentions are those given above but he omits the names of Col. C. Swinhoe and Dr. Sakharam Arjun.

In the Introduction in the first number of the *Journal*, January 1886, it is stated that the Society was founded 'by seven gentlemen interested in Natural History, who proposed to meet monthly and exchange notes, exhibit interesting specimens and otherwise encourage one another', but unfortunately it does not mention the names of the seven. The eight names given above were traced from the earliest Minute Book of the Society.

As No. 1, Vol. I, of the *Journal* may not be readily available to many present-day members, it may not be superfluous to quote further from the Introduction. The name of Mr. H. M. Phipson was not amongst the original founders, as I believe he was on leave in England at the time, but he must have joined the Society very soon afterwards, as the Introduction states :—

'For several months meetings were held in the "Victoria and Albert" Museum, but in January 1884, Mr. H. M. Phipson kindly offered the use of a room in his office in the Fort. This removal to a central situation gave an astonishing impulse to the Society. The meetings were better attended, the membership increased and collections began to be made, so that in a very short time the

necessity for more ample accommodation was pressingly felt. The committee appointed to seek for suitable rooms having failed elsewhere, recommended the Society to ask Mr. Phipson to let one-half of his office premises, including the room of which they had up to this time had the gratuitous use. He consented to this and so the Society continued to hold its meetings and keep its collections at 18, Forbes Street. Its progress was so rapid however, that these premises were soon felt to be too small and last month the collections were removed to larger and in every way more suitable rooms at 6, Apollo Street.'

It is well known that Mr. H. M. Phipson was the backbone of the Society from March 1886,—when he took over the position of Honorary Secretary from the late Mr. E. H. Aitken—to 1906, when he left India, and the success of the Society has been greatly due to his devoted labour on its behalf, and his wonderful personality, aided by other stalwart early members, such as the late

Mr. E. H. Aitken
Dr. D. MacDonald
Mr. Justice H. M. Birdwood
Mr. R. A. Sterndale
Mr. G. W. Vidal, C.S.
Mr. J. C. Anderson
Surgeon K. R. Kirtikar
Mr. W. F. Sinclair, C.S.
Rev. F. Dreckmann, S.J.
Mr. R. C. Wroughton

all of whom have passed away, but their work is evident as shown by the present flourishing condition of the Society, which has been so ably helped by so many past and present workers whose names are too numerous to mention in this brief note.

Mr. H. M. Phipson is, fortunately, still with us, living in England, and continues to take a great interest in the work of the Society.

TUNBRIDGE WELLS, KENT,

W. S. MILLARD.

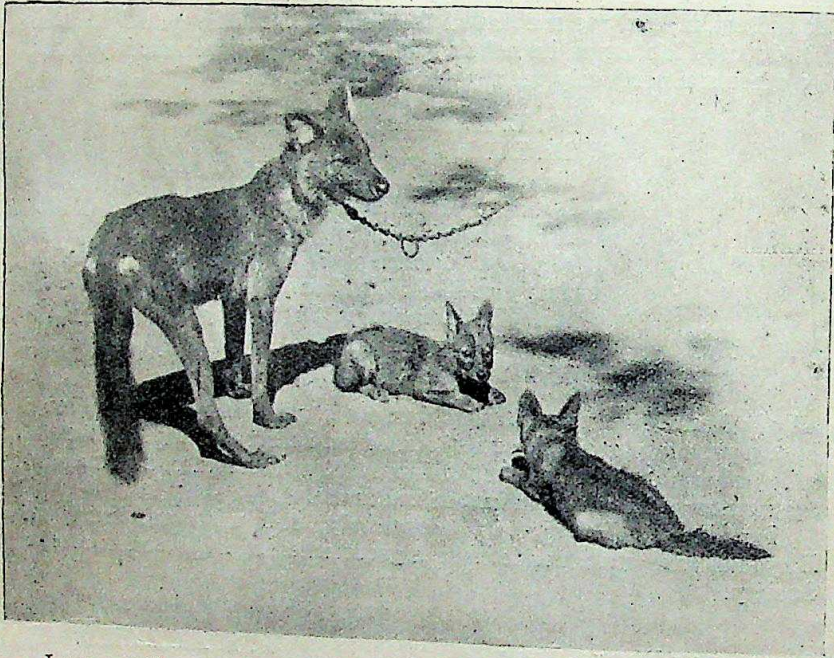
November 1930.

[It may be interesting to members to note that the original rooms used by the Society in 18, Forbes Street, still form part of the Society's premises. They are now used for the Taxidermy work of the Society. Mr. Millard is a link with the old founders. He joined the Society in the year 1888 and working in close collaboration with Mr. H. M. Phipson whilst he was in India he carried on his work as Honorary Secretary from the time of Mr. Phipson's retirement until the time came for him too to leave India—in April 1920. He has, however, continued to be an active official of the Society and as our London representative has lessened the labours of and earned the gratitude of the EDITORS.]

MISCELLANEOUS NOTES.

I.—A CASE OF HYBRIDIZATION BETWEEN THE WILD-DOG AND THE JACKAL.

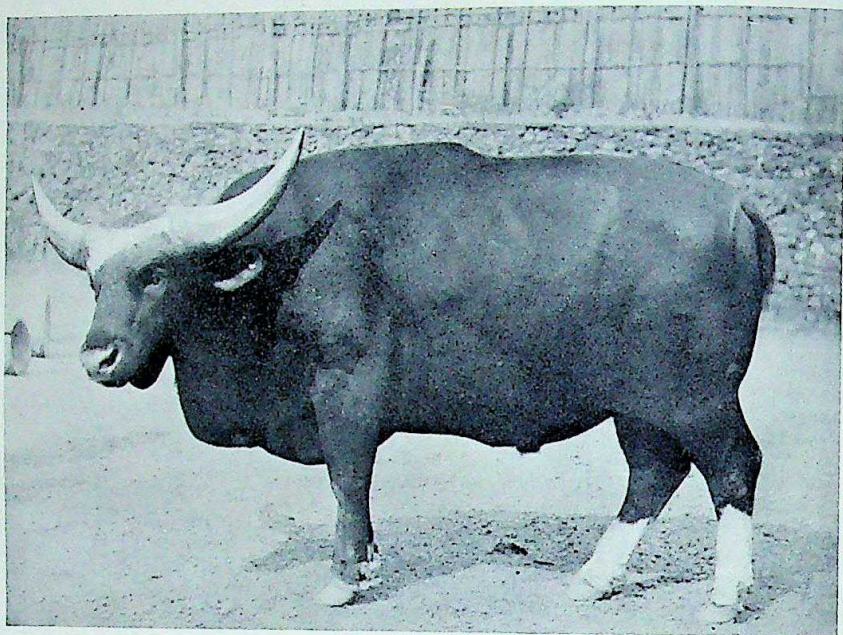
(With a photo.)



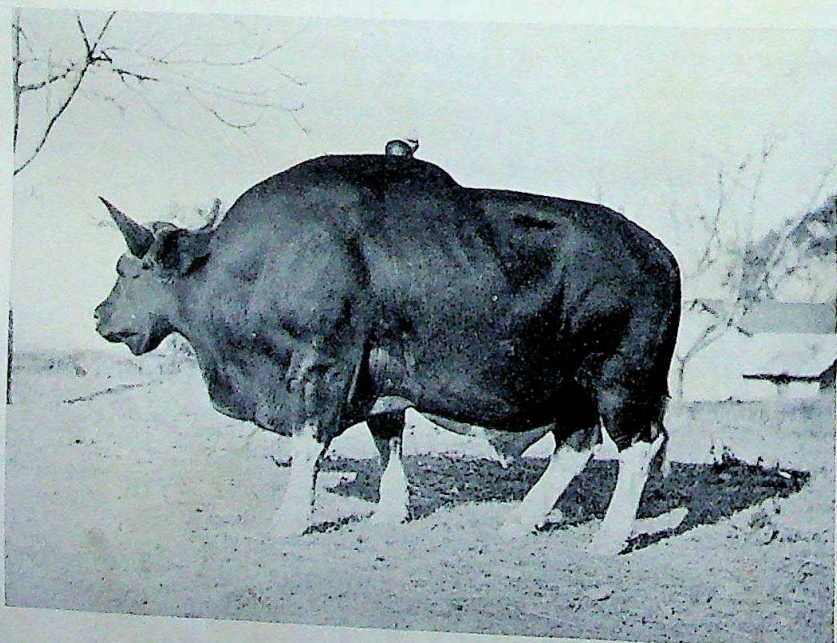
I am sending you a couple of snapshots that might interest your readers. At the Mysore Zoo, there were seven wild dogs at one time and as constantly many fights would ensue, they had to be separated. Owing to the limited number of cages and also to a certain extent as an experiment, a bitch was put together with a jackal in one cage. In due course intimacy was noticed between the two and on November, 27, 1930, two young pups shown in the photos were born. The mother is very good and looks after the young ones very well. The pups at present resemble the mother very much but it is yet too early to judge and take notes.

THE PALACE, MYSORE,
February 13, 1931.

SADEG Z. SHAH,
*Assistant Secretary to H.H. the
Maharaja of Mysore,*



A fine bull of the Mithan (*Bibos frontalis*, Lamb.).



Mithan (*Bibos frontalis*, Lamb.) showing dewlap and dorsal ridge.

[In vol. xx, p. 215 of the Society's *Journal*, Maj. H. W. Berthon describes an incident of a Jackal hunting with Wild Dogs. The Jackal was an accepted member of the pack which attacked a goat tied up for bait. The Jackal was shot and its skin and skull sent to the Society's museum where it was identified as a true Jackal. Maj. Berthon suspected that the Jackal was a hybrid. In vol. xxx. of the *Journal*, the late Mr. Tuggersee, D.F.O., Kanara, published a note on a hybrid Jackal and domestic dog.—Eds.]

II.—LARGE HEAD OF MALAY SAMBHAR

(*CERVUS UNICOLOR EQUINUS*)

I am in possession of a sambhar head shot in the Thayetmyo District the measurements of which I give below :

The head is a very massive one but I am aware is not a record by any means when compared with some of the heads procured in India. For Burma, however, it is large, at least I have never seen one approaching it in size.

I would be glad if you would let me know if it is anyway out of the ordinary.

Length	...	...	33"
Span	...	...	27"
Tip to Tip	...	...	24½"
Beam	...	...	at base just below first tine and coronet, 12½". Above first tine 8".

THAYETMYO,
BURMA,

A. L. BROWNLOW,
D. S. P.

December 23, 1930.

[The best head of the Malay Sambhar in Rowland Wards' *Records of Big Game*, (8th Edition), is in the possession of the D. H. M. Boyle. It measures L. 33"; circumference 53½"; tip-tip 28½"; widest inside 30". Mr. Brownlow's specimen is remarkable for its phenomenal girth. In the Society's collection there is a single antler of an Indian Sambhar picked up in the Nimar Jungles C. P. with a girth measurement of 12½".—Eds.]

III.—THE GAYAL, OR MITHAN (*BOS FRONTALIS*)

(*With a plate*)

Some years ago the sportsman who opened his game license in Burma found an astonishing entry—'one Mithan' among the animals he might endeavour to shoot! Was this a facetious pleasantry on the part of the Forest Department, or was there really such a beast? Was it a Myth—or a Mithan?

There is no such intriguing entry now,* so that Myth, or Mithan, may rest undisturbed by the thought of some restless Saheb stalking them with a rifle 'suitable for the purposes'. The joke is still perpetrated though, for the mysterious Mithan is still honourably mentioned—in the list of animals protected all the year round—which but leads us back to the question *what is a Mithan?* Those who have climbed up into the mountainous country between India and Burma will have seen this queer, sacrificial animal of the Chins, Kukies, Nagas and other hill tribes, and may be able to answer the question. For those less fortunate I humbly offer some photographs of Mithan taken in the Chin Hills which may enable them to visualize this strange beast and form their own opinion as to its existence. The resemblance to the wild Gaur or Bison is at once evident, and the more we see of this curious animal the more we are inclined to accept the conclusions of the eminent ornithologist Mr. Stuart Baker, that the Mithan—or Gayal as it is called in Assam—is specifically the same as the Bison. But this does not mean that the Mithan is exactly the same animal as the Bison is, only that their affinity is such that they can freely interbreed. The wild Bison—and there is nothing to show that it has ever been domesticated—is a larger and more powerful and more active animal than its domesticated relative the Mithan, and the horns are far larger, more corrugated, longer and with a characteristic angle that at once distinguishes it from the Mithan which—in the Chin Hills at any rate—has short and straight horns which are rarely corrugated. The skulls and horns of Mithan and Bison can be distinguished at a glance from one another as the two hang row upon row in the Chin houses.

In Vol. XV, No. 2 of the *Bombay Natural History Society's Journal*, 1903, Mr. Stuart Baker has given a masterly account, profusely illustrated, of the differences and resemblances of the two animals which is of great interest. He lived for years among these beasts and killed all the record heads and besides was a highly skilled naturalist and observer. He, however, was on the Assam border where apparently crossing between the Bison and Mithan still takes place to a considerable extent, and as we should suppose, the Mithan there very closely resemble the Bison: in fact there is a more or less gradual transition between the two. This is not quite the case in the Chin Hills, however, for there the Bison have been shot out to a great extent, and the opportunity for the two to meet and interbreed very rarely occurs. Enquiries over a considerable area only brought to light a single case which occurred about ten years ago. As may be then expected the differences between the two animals are more apparent in the Chin Hills than the resemblances, whereas on the Assam border the resemblances seem paramount.

In the whole of his article, however, Mr. Stuart Baker does not touch on what is perhaps the whole crux of the matter, and that is

* The Forest Department, in their Game Rules for the Shan States, still considers it a game animal though it has never existed in the Shan States or within hundred miles from the Shan States.

once again—what is a Mithan?—what causes the difference between it and the wild animal? The difference can be due to either the Mithan being the survival of what was once a species of light hill Bison peculiar to these hills—or to domestic cattle crossing with the Bison. There is nothing to support the first supposition—were it so. The Chins who are hunters to a man would have some tradition of it, and extinct animals do not so easily persist in a domesticated condition. This idea, if indeed it exists, may be dismissed. Nor is there the slightest evidence that the Mithan is a pure blooded domesticated Bison. Bison are extremely difficult to keep in captivity and Mr. Stuart Baker ridicules the idea. It is then the result—this strange beast—of the wild Bison crossing the domestic cattle of the people: such indeed is their own opinion of the origin of their Mithan (I speak of the Chins). In the *Gazetteer* of the Chin Hills of 1896, it is stated that 'The Chins tell us that the *Gavæus frontalis* is not a separate animal from the *Gavæus gaurus*, and that their Mithan are the results of a cross between the wild Bison bull and the common cow'. At the fourth generation the true stage of the Mithan is reached and then it breeds true—or if allowed with the domestic cattle—until it becomes almost obliterated. In the Chin Hills every stage between the Mithan proper and the common cow can be seen—until the high dorsal crest of the Bison has been reduced to a mere hairy thickening along the back. As the herds receive more and more cow blood the horns become cow-like and all the domestic cow's varied colours begin to appear.

Mithan are to be found throughout this mountainous tract, from North Cachar, through Manipur to the Lushai and Chin Hills, and south to Chittagong. They are a peculiar and characteristic possession of the Hill Tribes inhabiting those regions. In the Chin Hills they are usually herded into the house compounds at night and are in many cases more gentle and tractable than the domestic cow. 'As gentle as a Mithan' say the Chins, but there are exceptions to this rule, and I have had on more than one occasion to protect my horse from being gored at night by a crusty old wanderer out for blood. At such times they roar a peculiar bellow—not unlike a mule's which is of interest as the bison is a very silent beast. I have seen an old bull charge a Chin with incredible agility and toss him five yards away into the jungle—showing a bit of his wild ancestry. Usually they are timid and harmless enough as indeed are wild Bison till molested.

I shall not forget my first sight of a Mithan. I was riding along the hill path as it wound round a steep hillside when a slight sound above me attracted my attention. I looked up and some four yards distant a magnificent bull Mithan stood gazing down at me—a Bison but for his straight horns and the proximity of a village.

Mithan are said to be hardly as numerous as they were years ago in the Chin Hills and it would be as well to discourage their too frequent slaughter in sacrifice and feast until the stock is up again. A good bull is worth about Rs. 80 now.

It is interesting to speculate on the future of this fine animal—if it is to have a future—now that the chances of getting new wild Bison blood become more and more remote as the big game

becomes yearly less and less. It would be of great interest to introduce it into some other country where grazing is good, as in Australia. There it might prosper and grow to a larger size. The difficulty in most cases of acclimatization are here not present to hinder the experiment—for suitable animals can be bought in perfect condition at a reasonable price, and they are moreover docile and would not fret themselves to death during transit by sea and rail. I commend the idea for what it is worth.

If the question raised at the beginning of this article 'what is a Mithan' has not been answered, it has been raised at any rate for others to reply to, and it would be of interest to hear if they occur in other parts of the world where Bison have access to domestic cattle as they possibly have in the Malay States, Siam and Indo-China.

HAKA, CHIN HILLS,
November, 1930.

T. R. LIVESEY.

IV.—A NOTE ON THE OCCURRENCE OF THE TURKESTAN PENDULINE TIT (*REMIZ CORONATUS*) IN THE PUNJAB.

As Huhg Whistler's (*Journ. B. N. H. S.*, vol. xxiii, p. 153), appears to be the only record for the Punjab it may be worth noting that while staying at Lahore last cold weather, I came across a party of three of the above species on the outskirts of the Shahdara Rak.

They were feeding in a 'Ber' (*Z. jujuba*) tree, and I heard no note.

The party consisted of two ♂♂ and one ♀, all adult as ascertained by dissection.

The date was 1st February.

SIMLA,
January, 1931.

A. E. JONES.

V.—NOTES ON THE WHISTLING SCHOOL BOY OR MALABAR WHISTLING THRUSH

(*MYIOPHONEUS HORSFIELDI*, VIGORS).

In spite of the fact that it is a common bird throughout the hilly tracts of the Bombay Presidency, I think it is more often heard than seen; consequently a short description would not be unpardonable. Seen from a distance it appears like a diminutive crow with a slender bill, but on closer examination, its brilliant hues become visible. It is a black bird with the greater part of the feathers of the body and tail suffused with a rich cobalt blue. Added to this, the 'fore-head' and the lesser wing-coverts are a bright cobalt blue. The bill and feet are quite black, while the eye is brown.

On the whole this Whistling Thrush is a shy and retiring bird, lurking in the gloom of well-shaded rivulets, water-courses, and overhanging rocks and cliffs where there is a constant supply of water. In spite of its retiring habits the bird soon gets used to the proxi-

mity of man and will then come out of its hiding place without the slightest indication of fear. Though fond of water, it (in my experience with them) never inhabits the neighbourhood of still water, such as tanks. It is a regular bather and early in the morning may be observed engaged in having its morning bath, frequently entering the water during the hot weather. Often, it also engages in an evening splash as well. When disturbed, it flies up to the nearest rock or branch, bobs its head down, raises and spreads its tail like a fan suddenly closes it again, then erects itself and flies away giving forth a long, sharp, piercing whistle as it goes. This is the alarm whistle.

Generally single, in the breeding season they go about in pairs. They appear to preserve certain territorial rights for other birds of the same species are soon chased away if they happen to encroach on the preserve of another.

The breeding season commences with the break of the monsoon and may thus vary with the locality. Around the hills of Salsette, Khandala, and Mahableshwar, they begin to build in June, the eggs being laid soon after completion of the nest. The nests are built of moss and other vegetable fibre, sometimes lined with a few feathers. The nests are generally built in crevices and holes in overhanging inaccessible rocks.

The young are hatched in July. At first they are quite naked, but soon long black down-feathers are developed which stand erect. The skin is nearly quite black, and must protect them completely in the dark corners in which the nests are usually situated. The down feathers are highly sensitive and readily react to the slightest touch, even to that of a fine hair. I have frequently tested this point. This is what makes me inclined to believe that these long down-feathers are of a protective value to the young birds, for in the places where the nests are built, there are to be found innumerable mosquitoes and small flies which no doubt constantly harass them. That mosquitoes do worry them I have not the slightest doubt as it has been amply proved to me by the birds I have had in captivity. Between August and September the nestlings are able to fly. The down-feathers are gradually replaced by ordinary feathers to the extremity of which the down feathers remain attached for some time before they fall off. Those of the head are the last to be shed. The feathers are at first quite black but in time become suffused with the cobalt blue like the adult. The lesser wing-coverts are the first to become cobalt blue and when these have developed, the feathers of the crown follow—this is the last to be developed. Even when moulting, the blue of the feathers appear some time after the feathers have developed and not as soon as they appear.

The food of these birds consists chiefly of snails, small frogs and insects, and possibly of a little vegetable matter. Crabs are also largely eaten, so also are worms. Snails and crabs are hammered against the rocks to break the shells which are not eaten in either case.

As I have said, these birds are more often heard than seen. It is their beautiful whistle which first attracts the attention. So human and full are the notes that they have frequently deceived the

listeners. There is no uniform song but one note is followed by the other much like the awkward whistling of a boy. It is in the mornings and in the evenings that these birds like to whistle best. But the monsoon is the time to hear them. It is just the time for them when there is plenty of mist and fog about and slight showers of rain.

In captivity they make most delightful pets, though they are a little dirty on account of their diet. They soon become very attached to their masters. At times they are inclined to be pugnacious, particularly towards strangers. Two can seldom be kept in the same cage as they will invariably fight. The young are somewhat difficult to rear at first owing to their delicate nature and diet. The diet in captivity should consist of hard boiled eggs and raw meat cut up into tiny pieces, to this may be added some greens and fruit. When possible, small frogs, not toads, crabs and insect-food should be given to them. A liberal supply of water should always be provided. When almost full grown, a tray with water should always be put into the cage for bathing purposes.

When taught to whistle early, these birds are excellent mimics and are able to whistle any tune. One that I had for some years, was able to whistle the song '*For me and my girl*' right through quite correctly and one or two bugle calls. There are few birds in India which are so adept in whistling.

In captivity these birds, if well looked after, will live long. I have had them for as many as seven, eight and nine years and in all cases an accident was the cause of death. One that I have at the moment, has been in captivity for the last eight years. In captivity, they moult regularly every year, just after the monsoon, usually commencing about September. It takes about two and a half to three months to complete the moult. During this period the bird is somewhat quiet. The wing feathers are the first to fall, followed by those of the tail. Then those of the body and lastly from the head. During the casting of the wing and tail-feathers many of the body feathers also fall.

BOMBAY,
November, 1930.

C. McCANN, F.L.S.,
Assistant Curator, Bom. Nat. His. Society.

VI.—A NOTE ON THE NIDIFICATION AND HABITS OF THE TRAVANCORE LAUGHING-THRUSH.

(*TROCHALOPTERUM JERDONI FAIRBANKI*).

(*With a plate*)

I have just received a copy of the lately-published *Birds of Southern India* by Lt.-Col. H. R. Baker and Mr. C. M. Inglis, from which I see that the note therein with regard to the nest of the above reads as follows. . . . 'It is, in shape, a deep cup made of moss, roots and tendrils lined with fern-stems and fine bents, etc.'



1. Travancore Laughing-Thrush at Nest.
(*Trochalopteron jerdoni fairbanki*.)



2. Nest of Travancore Laughing-Thrush.
(*Trochalopteron jerdoni fairbanki*.)

Of its habits nothing whatsoever is recorded in this volume. On turning to *The Fauna of British India—Birds*, we find no information about the nest but its habits are said to be similar to those of *cachinnans*, of which the following is written—'It is always found in parties, sometimes consisting of a dozen or more birds, and is one of the noisiest of the family. . . . It keeps much to the ground and to dense undergrowth, and though its diet is mainly insectivorous, Jerdon remarks that it feeds principally on the imported Peruvian Cherry (*Physalis peruviana*). It is said to be a shy bird except in the breeding season, when it sits very close and becomes much bolder.'

The notes on *cachinnans* in *The Birds of Southern India* read—'A very common permanent resident on the hills where it frequents undergrowth, hedges and gardens; it usually associates in small parties, the members of which keep up a continual cry of *Pee-koko*, *Pee-koko*, from which the bird drives its local name. It is not particularly shy, yet evinces a disinclination to come out into the open, preferring to escape notice by hopping and creeping amongst the bushes.'

From the above, we are now in a position to know something about the Travancore bird's mode of living and nest-building, but I venture to suggest that the normal nest of *Trochaloxyeron jerdoni fairbanki* is not as stated above, nor do the habits of *cachinnans* as given here, quite fit this bird, at any rate in so far as those observed around Kodaikanal are concerned.

I spent April and May of 1928 in the Palni Hills, and besides a number of old nests, I found the following six occupied ones :—

- No. 1. 4th April. Empty, but practically finished.
- No. 2. 23rd „ In such a very thick hedge in the bungalow compound that I was unable to get at it, but the two young ones left the nest on this date.
- No. 3. 24th „ Construction just begun. Contained two eggs on 7th May.
- No. 4. 29th „ Two eggs.
- No. 5. 6th May. One egg, but two next day.
- No. 6. 19th „ Two newly-hatched young ones.

Firstly, as regards nest materials. No. 1, I thought was not very dissimilar from many nests of *cachinnans* which I have seen, but as I discovered it torn out and lying on the ground the following day I pulled it in pieces, finding it made up as follows :—The extreme outside was chiefly of moss which formed possibly 20% of the entire structure. Coarse grass formed the remainder, while the lining appeared to be still wanting. This was the only nest in which moss had been employed to any appreciable extent, although No. 4 had a very small quantity incorporated in one side of it.

No. 3. I observed from its very inception. In fact had I not seen the birds fly into the bracken with material, I would never have realized that the half dozen untidy-looking strips of coarse grass were the foundations of a nest. This nest, which is the one containing eggs shown in the plate, was also destroyed, and but for the bracken leaves which are visible in the photograph, was exclusively of dry

grass with a lining of slightly finer grass. No. 6, also built in bracken, was an exact replica of this one.

No. 5 had two small feathers and one hair mixed up with its grass lining. The remainder, including the old ones I mentioned, do not call for comment. In fact, a general description of the nest as visualized by me would run as follows:—Moss is seldom, and then only scantily, used. The structure is composed almost exclusively of coarse grass, very compactly put together, with a deep cup, lined with slightly finer grass. At times bracken leaves or other materials, depending on the site of the nest, are also used to a limited extent.

As regards habits, reading the note on *cachinnans* in *The Birds of Southern India* in conjunction with that in *The Fauna* a very fair idea of *fairbanki*'s habits is obtained, but my own impressions are that it is more of a 'garden' bird than *cachinnans* and on the whole much bolder. Whereas the Nilgiri bird's stronghold seems to be the sholahs, and to a lesser extent patches of undergrowth and gardens where a sufficiency of cover exists, *fairbanki* seemed to me to shun the deeper woods, inhabiting the very edges of the sholahs, bush-dotted hillsides, and the extensive patches of bracken which clothe them, while every garden, however small, within Kodaikanal itself boasted its inhabitants. These latter birds move about the rose bushes and other plants searching for insects in quite an open manner, while the pair mentioned as having a nest in our own compound were very keen on a tall wire-netting fence. On three occasions I stood in the doorway only 8 feet distant while they fed their two young ones clambering about the top rail.

I do not agree that either of these birds keep much to the ground. They are certainly not averse to descending to it, but by far the greater part of their existence is spent in creeping about low cover or bushes at from 2 to say 6 or 8 feet up, sometimes descending to the ground as occasion arises.

The first nest mentioned, in an upright fork of a tall bush, was the only one I found in a sholah and this was in a comparatively open portion near a stream. The majority of nests were either in an upright fork in the densest part of a rather isolated bush on a bush-dotted hillside or else anchored in tall bracken which abounds all over the summits of the Palnis. These bracken nests were usually no great distance from the edge of a sholah or other cover, nest No. 6 being the most isolated, being some 40 yards from the edge of a pine-wood on the one hand, and 60 yards or so from a small stream on the other hand whose banks sported a certain amount of cover. Incidentally I never saw the birds visit the wood which after its kind had no undergrowth whatsoever.

The statement in *The Birds of Southern India* that 'It usually associates in small parties, the members of which keep up a continual cry of *Pec-koko Pec-koko*', is rather misleading. I have watched numbers of both races, including birds at the nest from the hiding-tent and parties feeding, and have always noticed that this cry is used by one bird to call up its mate, or companion (?), when they are separated. One of the photographs here shows a bird on the nest answering its mate which had just called out twice from

where it was feeding in the bracken some 200 yards away. A couple of such calls and answers and all would be quiet again for some time until one or other of the birds, apparently becoming anxious, would raise its head high in the air, puff out its chest, and crow loudly once, twice, or thrice until it received an answer. Incidentally I never saw the Travancore bird in more than family parties, though, of course, they may become more sociable out of the breeding season.

The above impressions are the result of but a two months' acquaintance with this bird; so if some of my conclusions are incorrect, perhaps there is an ornithologically inclined member resident in Kodaikanal who will point out the discrepancies.

BAREILLY,
December 23, 1930.

R. S. P. BATES,
Captain.

VII.—THE OCCURRENCE OF THE GOLD-FRONTED FINCH (*METAPONIA PUSILLA*) AT SUKKER, SIND.

The *Fauna* gives the distribution of the Gold-fronted Finch (*Metaponia pusilla*) as follows:—Caucasus, Mountains of Central Asia, Persia, Afghanistan, Kashmir, Ladak and Tibet. It is therefore worth recording that I was lucky enough to obtain a fine specimen of this finch on January 1, 1928, at Sukkur, Sind.

I was out collecting about a mile below the Barrage, and was passing through some interesting cultivation near a village, when I flushed about five birds, which I at once recognized as something I had not seen before. They were very restless and difficult to approach. However, I managed to obtain one specimen, the others took flight, and disappeared out of sight over the top of some tall trees. I failed to find them again. The bird I obtained proved to be a juvenile male.

This finch has not been recorded from Sind before, and Dr. C. B. Ticehurst does not mention it in his list of Sind Birds.

BARRAGE TOWNSHIP,
SUKKUR, SIND,
February 10, 1931.

F. H. COLE.

VIII.—THE NESTING OF THE MALABAR HEART-SPOTTED WOODPECKER (*HEMICIRCUS CANANTE CORDATUS*) IN TRAVANCORE.

I have received the following most interesting account of the nesting of this bird in Travancore, from Mr. C. Primrose. It is so widely different from the account given by Mr. Stuart Baker in *The Fauna of British India (Birds)* 2nd edition, that I am sending it to you for publication in the *Journal*. Mr. Primrose wrote:—

'I am sending you two eggs of *Hemicircus c. cordatus* taken on November 26, and December 15, respectively. These I have

little reason to doubt, were laid by the same bird as the following details will show. The first nest, a shallow tunnel of some 5 inches in depth, made in a rotten fencing post, 3 feet from the ground, was taken by me and contained one fresh egg. Shortly after I noticed another nest being excavated on a similar post about 50 yards further along the line of fencing and, waiting till I judged the bird had time to lay, took this as well finding one fresh egg as before. The fence runs along a much-frequented path near the jungle. Both nests were not more than 3 feet from the ground and in shape the entrance was much pointed at the upper end. The bird on hearing one approach climbs up and keeps a look-out from just inside the hole, its creamy-yellow forehead and upper breast blending well with the background of the newly-worked rotten wood. It allows a close approach before leaving the nest and then only goes a short distance away and looks anxiously at the intruder, uttering its characteristic and rather metallic note and bobbing about in a jerky manner. It returns to the nest very quickly if one conceals oneself and after a look round, whilst perched at the entrance, with a final Kestrel-like bob disappears inside. I shall keep a further look-out along the many miles of fencing held up by rotting posts round this estate and see if I come across more. Incidentally the fencing posts where these nests were taken were within a few yards of heavy forest containing many dead trees and branches. The bird is certainly common here, usually seen in pairs, which attract one's attention by their noisiness'.

HULDIBARI T.E.,

BINNAGURI P.O.,

DUARS,

January 19, 1931.

CHAS. M. INGLIS,

F.Z.S., F.E.S., M.B.O.U.

IX.—THE NESTING OF THE BESRA SPARROW-HAWK (*ACCIPITER VIRGATUS AFFINIS*) AT SIMLA.

In his articles on the *Birds of Prey of the Punjab* (J. B. N. H. S., vol. xxvii, pp. 139-140), Mr. C. H. Donald in his note on the above species says there are no nesting records for the province.

It is therefore worth setting down particulars of a nest which came under my observation this year on 25th and 27th May.

In the first place I ought to say that it was entirely due to the strange vociferations of the male that my attention was drawn to the fact that there was to me a strange bird-noise going on in the neighbourhood, and so sat down to investigate.

Looking in the direction from which the sound came, I saw another bird fly into the tree. From my coign of vantage I was unable to see what ensued, but I certainly think the male had called the female off the nest on account of some tit-bit he had brought.

Watching in the direction of the sounds, I had, after an interval of about six minutes, the pleasure of seeing the female fly to a nest of

sticks 60 feet up a Deodar (*C. deodara*). She stood on the edge of the nest for some seconds, and then settled down on the eggs.

For forty minutes I sat watching her through the glasses, during which time she shifted round an axis of about 135 degrees. Standing up she preened herself after which she settled down again to incubation duties.

Two days later, with my climber, I again visited the spot, a quiet nullah in deep forest composed almost entirely of Deodars.

This time, as the climber ascended the tree, she sat down very low in the nest, but when he was half way up, she stood up and waited on the edge of the nest, then flew to an adjacent tree where she assumed an aggressive attitude.

The nest contained four highly incubated eggs which are white with just a tinge of green and are sparingly marked with small spots of sienna brown.

SIMLA.

A. E. JONES.

X.—FURTHER RECORD OF THE MALLARD (*ANAS PLATYRYNCHA*) OCCURRING IN BURMA.

I am sending you by separate registered post the head, wings, feet and tail of a duck recently shot by me at Hnokcho, Bhamo District, on the Theingaw *jheel*. It was identified by Mr. C. E. Milner, Conservator of Forests, from Blandford's book on *Fauna of British India—Birds* as a female Mallard, but considering the very rare occurrence of this bird in Burma, I should like Mr. Milner's identification verified. If it really is a Mallard, then it is the third that has fallen to my gun within the last 4 years, the other two being recorded at page 577 of vol. xxxiv, No. 2, of your *Journal* as having been shot during the winters of 1926 and 1929.

BHAMO FOREST DIVISION,
BHAMO (UPPER BURMA),
December 5, 1930.

G. M. TURNER,
Dy. Conservator of Forests.

[The bird was received and identified by us as a Mallard (*Anas platyrhynchos*). This constitutes the third record of this species from Burma in recent years. Eds.]

XI.—THE OCCURRENCE OF THE SPOTBILL OR GREY DUCK (*ANAS P. PÆCILORHYNCHA*) IN UPPER CHINDWIN, BURMA.

I send herewith the upper mandible and speculum of what I take to be the Indian Spotbill, *not* the Eastern Spotbill which is the common bird in Burma *vide* Stuart Baker. Unfortunately I have not got the book on tour. So cannot see exactly what he says, but the key is if

I remember—green speculum, red spots on bill, species Indian.
 —purple speculum, no red spots on bill, Burmese species.
 I never remember to have shot one with any red on the base of the bill anywhere else during 20 years in Burma; but on this my first visit to the Chindwin the only two Spotbill brought to bag, on different days and on different jheels have both been like the enclosed. Dates 7th and 11th January. Locality near Homalin, Upper Chindwin.

Geese: all the geese seen on the sandbanks on the Chindwin (and we have seen 2-300) are Bar-headed (*Anser indicus*) whereas all the geese we shot on the Irrawaddy jheels near Katha, Bhamo and Mandalay, also Wellet in the Shwebo District where there are thousands—I mean thousands—are Grey Lag (*Anser anser*). Similarly at Pavyo and other jheels between Mandalay and Mingyan and Paunglin near Magwe, the geese are Grey Lag, and one only occasionally sees or gets a Bar-headed. I have two records, Paunglin Magwe—Xmas 1911, and Tiqyaung, Katha—November 1930.

Grey Lag are also seen on the Chindwin jheels but in nothing like the numbers one sees on the Irrawaddy.

White Eye (*Nyroca rufa*): Until I got the new edition of *Indian Ducks*, I have always shirked identifying Baer's, the common White-eye and the Tufted Duck as all are in eclipse plumage here at Xmas: but the new key is more helpful and out of three pochard shot near Homalin on January 7, 1931, one was certainly a common White-eye (*Nyroca rufa*) and two Baer's White-eye (*N. rufa baeri*).

Some years ago I sent you another record from Wellet, Shwebo—Xmas 1920-1927, identified by Mr. J. C. Hopwood as Baer's.

SYLVAN LODGE,
 MAYMYO,
 BURMA.

E. MILNER.

[The well defined red markings of the bill and green speculum appear to indicate that the specimen secured by Mr. Milner is an example of the Spot Bill or Grey Duck (*Anas p. pæcilorhyncha*). The Burmese Grey Duck (*Anas p. haringtoni*) has no red spots on the bill or only faint traces of them. In the Eastern Grey Duck (*Anas p. zonoryncha*), the red spots on the bill are absent, and speculum is blue. This appears to be the first record of this duck in Burma. The Eastern White-eye (*N. baeri*) is generally an unrecognized winter visitor to Burma. It is of interest therefore to publish records of its occurrence in the above note by Mr. Milner and in the succeeding note by Mr. Turner. Eds.]

XII.—OCCURRENCE OF THE TUFTED POCHARD (*NYROCA FULIGULA*) AND THE EASTERN WHITE-EYE (*NYROCA BAERI*) IN BURMA.

I am to-day sending you per registered parcel post the complete skins of two ducks shot by me on the 7th January 1931, on a small isolated jheel surrounded by dense cover on one of the islands in the

Irrawaddy River about 10 miles below Bharno. I have identified them from Stuart Baker's *Indian Ducks and their Allies*, as being (1) the Crested or Tufted Pochard (*Nyroca fuligula*) and (2) the Eastern White-Eye, *Nyroca baeri*. For one identification mark that is not now visible; I might mention that the irides of the former were a bright yellow, and of the latter white. The white spot under the chin of the latter was also much more distinct than it is now after skinning. Both birds were solitary.

I shall be glad if you will confirm the correctness of my identification of the two birds, and if you consider them of sufficient interest, record the incidents in the next issue of your *Journal*, as Stuart Baker seems to consider them somewhat rare winter visitors to Upper Burma.

BHAMO FOREST DIVISION,
January 15, 1931.

G. M. TURNER,
Deputy Conservator of Forests.

[As indicated in the previous footnote, the Eastern White-Eye is described as probably a regular though undetected winter migrant into Burma. The new Edition of the *Fauna* does not mention the Tufted Duck as occurring in Burma though Hume considered it a probable straggler. The specimens submitted to us are as identified by Mr. Turner. EDS.]

XIII.—OCCURRENCE OF THE CLUCKING OR BAIKAL TEAL (*NETTION FORMOSUM*) NEAR HARDOI, U.P.

I am sending you the head and wings of a duck which I think is a Clucking Teal, shot at Sandi Jheel, near Hardoi on January 24. It was flying in company with some Pintail only lower down when it was shot. As it is, according to the books, one of the rarer ducks, I thought it might be of interest to you. I would be very grateful if you would identify it for certain. I could not send the body as it was going bad, but in size it was about that of a very large Garganey and just too small for an ordinary duck. It was a kind of dove grey. I hope the head arrives all right.

LUCKNOW,
January 29, 1931.

H. SCOTT MACDOUGALL,
Capt., 60th Rifles.

[The duck was received by us and identified as the Clucking Teal [*Nettion formosum*]. EDS.]

XIV.—NOTES ON THE WHITE-HEADED DUCK OR STIFF-TAIL (*ERISMATURA LEUCOCEPHALA*)

While shooting an open jheel near Chillianwala, Gujrat District, Punjab, with Captain J. R. M. Hanna and Captain A. H. B. Joyce, M.C. on February 22 this year, we came upon a flock of eleven white-headed duck of which we succeeded in shooting three. An adult drake and duck, and a drake not yet in full plumage.

As I see in Stuart Baker's *Game Birds of India, Burma and Ceylon* that these are rare duck I am sending some details.

I saw these birds lying out in the middle of the jheel and with the sun behind them. I believed them, at first, to be coots, as, although we had fired all round the jheel, they had not risen.

Later I walked round to the far side of the jheel and noticed the white heads of two of the drakes and recognized them as Stiff-tail, (I had come across them previously near Nowshera in 1928).

The heads of the drakes showed up brilliantly white in the sun, while the ducks at the same distance were unrecognizable.

Of the eleven, two appeared to be drakes in full plumage, and the remainder ducks and immature drakes.

I waded in and a coolie was sent in to endeavour to turn them towards me. They all passed within 60 yards of me.

While swimming, their tails were generally lowered in the water, but when at rest on the water, the tails were erect.

The coolie drove them to one end of the jheel and on my approaching in the water they got up and flew back to the other end, a matter of eight hundred yards.

Their appearance on the wing is very coot-like, but they fly much faster. I fired at one of the mature drakes and he came down, still very much alive, and immediately dived. He remained under water for about a minute and then reappeared for a couple of seconds showing his head only. There was no reed in the water, so this duck has undoubtedly the power of swimming with only the head and neck projecting above water. He kept up these 'Submarine tactics' for nearly ten minutes before I got near enough to kill him outright. Towards the end, when I suppose he was tired, he commenced showing more and more body above water.

The other two were killed outright from the bank.

The drake weighed 1 lb. 10 oz.; he was very fat.

There appeared to be little difference in the size of all three secured.

I examined the contents of the drake's stomach which I found to consist purely of vegetable matter.

In comparing the adult with Keulemans' illustration, I notice that in my specimen the tail is more squarely cut, each of its twelve feathers being approximately the same length and definitely black.

The eye is darker than in the illustration. There is no trace of brown in the feet, which are the same colour as, but slightly darker than the blue grey bill. The webs are black.

I have kept the drake's skin, which I should be glad to send you if it is of interest.

The Stiff-tail is poor eating. Their flesh being rank and rather coarse.

JHELUM,
PUNJAB,
February 27, 1931.

W. A. WHITEHEAD,
Capt., 1st Punjab Regt.

XV.—SOME RACES OF THE RED-BILLED CHOUGH
[*PYRRHOCORAX PYRRHOCORAX* (LINN.)].

The Red-billed Choughs are distributed over a considerable portion of Europe, Africa and Asia. Curiously enough, they are grouped under the binomial *Pyrrhocorax pyrrhocorax* (Linn.), from which we assume that ornithologists are generally of opinion not to recognize any but the typical form. The approximation of body-colour of birds of the different areas naturally leads to the suspicion that there has been hardly any influence of environment at work on these Choughs, which apparently do not react to the conditions of the climate, soil and food. John Gould, however, in his examination of the Himalayan Chough detected differences in point of size, which left him in no 'hesitation to describe it as distinct' (*P. Z. S.*, 1862, p. 125) from European examples. In the dust of criticisms and controversy which subsequently raged over this point, drawing in their vortex such distinguished scientists as August Von Pelzeln, W. T. Blanford, Allen O. Hume, Ferdinand Stoliczka, etc., the true significance of Gould's observation was lost, the concensus of opinion among ornithologists deeming it absurd to found a specific distinction on the dimensions of the Chough. Recent studies, however, of the birds bring home the fact that while it is difficult, nay impossible, to ignore the above decision, it is nevertheless easy to differentiate them as geographical races or subspecies, separated from one another by immense barriers of land. The continental *Pyrrhocorax* of the Alps, if not the form found on the British Isles, is reckoned as the type, though the former is appreciably a bigger bird in respect of size. Witherby records (*A Practical Handbook of British Birds*, p. 32), measurements of British birds—♂ wing 270–310 mm.; tarsus 55–59 mm.; bill from nostril 49–58. ♀ wing 265–285 mm.; bill from nostril 42–47. Dr. Stresemann mentions (*Journal für Ornithologie*, lxxvi, 1928, p. 343), the Choughs collected by Von Gerd Heinrich in Elburs Expedition of 1927 as a distinct race (*Pyrrhocorax pyrrhocorax pontifex* subsp. nova. Typus in Zoolog. Museum, Berlin, Nr. 27. 819; Gilan: Pish Kuh 2500–3000 m. 2 Mai 1927) which, though agreeing in colouration with the European examples is decidedly larger in dimensions. Measurements recorded thereof are for 3 ♂♂ and 2 ♀♀. ♂ 318, 320, 327 mm.; ♀ 293, 305 mm. So far the difference that has been noted in respect of the birds from different areas is only one of degree, the body-colour in the European and Elburs examples being glossy black with distinct green iridescence on the wings and tail. The measurements of the Himalayan Chough recorded by Gould (*P. Z. S.*, 1862, p. 125) is—wing 324.5 mm.; tarsus 57 mm.; bill 57 mm. This is fairly corroborated by Blanford (*J. A. S. B.*, vol. xli, p. 70) who records—♂ from Sikkim, wing 324.5 mm.; tarsus 61.5 mm.; bill from gape 58 mm.; ♀ wing 292.5 to 312.5 mm. Stuart Baker's measurement noted in *The Fauna of British India, Birds* (2nd Edition), p. 68 is, however, clearly less and appears to tally with that of the continental if not the English birds. In Himalayan birds, Dr. Stresemann points out, the green iridescence of the wing and tail-feathers is not found and is replaced by a clearly blue gloss with a slight shade of violet

(*Journal für Ornithologie* lxxvi, 1928, p. 344). Recently, while revising the bird-collection of the Indian Museum, I have had opportunities of examining a large series of the Himalayan *Pyrrhocorax*. I notice extraordinary variations in respect of the culmen (50-103 mm.) and tarsus (50-65 mm.) both in male and female, the maximum measurement of the wing being 326 mm. The following are measurements of some specimens:—

Reg. No.	Sex	Locality	Wing	Culmen	Bill from Nostril	Tarsus	Middle toe without claw
19334	♂	Leh, Ladak.	326	56	51	53	25
19333	♂	Leh, Ladak.	322	56	49	55	25.5
16381	♂	Gilgit ...	316	50	44.5	56	24
6051		Ladak ...	316	55	48	50	25
24954	♀	Tibet ...	310	52	49	58	25
1173	♀	Si-kim ...	308	53	47	65	27
1174	♀	Sikkim ...	302	51	46	60	26
24647	♀	Bhutan ...	301	73.5	66	65	30
24198	♀		300	103	96	63	30
8286	♀	Bhutan ...	291	80	73	60	27

A living specimen (probably ♀) from the Himalayas, belonging to the Calcutta Zoo, measures as follows:— wing 300 mm.; culmen 98; bill from nostril 92; tarsus 66; middle toe without claw 30 mm.

It appears from reference to above that the measurements recorded for the Himalayan Red-billed Choughs by Gould and Blanford are, by no means, the maximum, and are very often exceeded. This is fairly corroborated by Col. R. Meinertzhagen in his systematic results of birds collected at high altitudes of Ladak and Sikkim (*Ibis*, July 1927, p. 372). The following are measurements noted by him:—

Sex	Locality	Wing	Culmen	Tarsus
♂	Leh ...	340	60	56
♂	Sikkim ...	330	57	61
♂	Sikkim ...	332	60	59
♀	Sikkim ...	309	55	56

It is worthy of note that while Meinertzhagen's birds have extraordinary wing-length exceeding the maximum I have observed in

the collection of the Indian Museum, the measurements of culmen and tarsus noted by me are remarkably larger than the maximum noticed by any other ornithologist. The female birds are invariably smaller in point of wing-length, though their culmen and tarsus are often disproportionately larger. The larger dimensions of these birds and the blue gloss on their primaries will, therefore, mark them out from their European cousins. The wing-length of the latter seldom exceeds 310 mm., a character which is fairly constant at least for the individuals of the British Isles. Dr. Hartert appears to consider it impossible to distinguish with any degree of satisfaction the forms in Palæarctic fauna District of W. Europe to E. Siberia. Witherby records that the European birds have greyish brown feather-bases. In my examination of the Himalayan Choughs I find that these are brownish black, lighter in tone and rather inclined to be purplish. The subspecies from Elburs mountain recognized by Dr. Stresemann as *Pyrrhocorax p. pontifex* has very much larger wing-length and is almost indistinguishable in point of size from the Himalayan examples, but the green iridescence of their plumage appears to give them a character of their own. The individuals from North China, described by Swinhoe as 'variety brachypus' (*P. Z. S.*, 1871, p. 383), are recognized by La Touche (*Handbook of Birds of Eastern China*, p. 22), as a well-established race, which resembles the Indian form in colour but is definitely smaller in size: measuring, wing 256-298 mm.; culmen 43-48; tarsus 43-49; middle toe without claw 22-30 mm.; While recognizing the small size of the Choughs of the Tian-shan, Dr. Stresemann records (*Journal für Ornithologie*, 1928, p. 344) that they are lighter in colour and inclined more to blue shades, standing halfway between the Elburs and Himalayan forms. Here for the first time an intergradation is apparent. They have, says Dr. Stresemann, decidedly sharper wings than the Himalayan birds. This variation in the shape of the primaries does not appear to have been noticed by any other ornithologist. It is a character far reaching in its importance, and we must await fuller details about the birds, which Dr. Stresemann is inclined to recognize as *Pyrrhocorax p. centralis* sub-sp. nova. There are in the collection of the Indian Museum a few skins of the Choughs of Turkestan whose measurements are noted below:—

Reg. No.	Sex	Locality	Wing	Culmen	Bill from Nostril	Tarsus	Middle toe without claw
14194	♂	Turkestan	310	52	45	55	27
13269	♂	"	303	54	46	52	25
13283		"	293	48	42.5	48	24
14195	♀	"	277	46	40	53	28

These are appreciably larger than Stevens' records of Turkestan specimens published in *J.B.N.H.S.*, vol. xxix, p. 527. Here the maximum measurement hardly corresponds to the minimum of the

Himalayan subspecies. The extraordinary dimensions of the latter, which is more or less isolated in its distribution area, are not found anywhere else.

The following key may be adopted for identification of the different forms :—

Key to subspecies

- A. Gloss on wings *green*
 - a. Wing under 310 mm. ... British and W. Palearctic form (*P. p. pyrrhcorax*)
 - b. Wing over 310 mm. ... Elburs (*P. p. pontifex*)
- B. Gloss on wings *blue*
 - a. Wing under 310 mm.; culmen and tarsus smaller under 50 mm. ... N. China from (*P. p. brachypus*)
 - b. Wing over 310 mm.; culmen and tarsus larger over 50 mm. ... Himalayan (*P. p. himalayanus*)

Habits and Field Characters

While in Britain, *Pyrrhcorax p. pyrrhcorax* (L.) is found in rocks and cliffs on or close to the sea-coast, nesting usually in crevices in roofs of sea-caves and hollows of rock-walls, the continental race generally affects higher mountains inland, and sometimes, though very seldom, nests in old castle, tower or human habitation. Flight buoyant, graceful. Call clear, shrill—'Kria, or dla dla' (Hartert); 'a soft K'chule, and a rather querulous tchare' (Witherby for Br. Birds). Food varied as with *Corvidæ* generally. Nest.—Bulky. Eggs.—4 to 5 or more, 39.4×27.9 mm. (Witherby's average of 100 eggs); larger with continental forms (maximum 43.2×28 mm. recorded by Hartert); creamy white, occasionally pale green, with faint purplish grey and light and dark brown blotches.

Pyrrhcorax p. pontifex (Stresemann) nests in inaccessible mountain-tops. Young observed and heard cawing by Heinrich in the end of May. Congregations of young and old observed by him on 28th July.

Pyrrhcorax p. brachypus (Swinhoe) is a common resident in the mountains of Chihli, apparently extending its range towards E. Siberia; great flocks gather in higher hills in late summer. Eggs.—white, speckled and spotted irregularly with reddish brown over violet grey spots, the latter on the surface as well as within the shell; a zone round the large end; shape ovate; 40×27.5 , 38×28 mm. (La Touche).

Pyrrhcorax p. himalayanus (Gould) occurs throughout the Alpine regions of Ladak, Kashmir, and Sikkim, in winter as low as 5,500 and as high as 16,000 ft. in summer to and even beyond 18,000 ft. (*Ibis*, 1927, p. 372). Wollaston records them on Everest (20,000 ft.) in September (*Ibis*, 1922, p. 526). In the Sikkim Himalayas it appears to be confined to the far interior, where there has evidently been no decrease in their numbers since Hooker recorded them in

1849 around *Lachen* (*J.B.N.H.S.*, vol. xxix, p. 517); rather scarce, according to Blanford, on the Cho La Range; found in winter in the valleys and plains where they apparently migrate at the season. Equally at home on deep snow, grassy meadow, cultivated ground, or on barren plains. Numerous in Ladak from 10,000 ft. and upwards as much near villages as far away among rocky crags; mixing commonly with crows, ravens, pigeons on ploughed fields or irrigated land. While in search of food which is mostly secured on the ground, they set to work, in pairs or parties, probing their bills deep down into the earth. 'Seen about places where yaks have been herded, hunting for insects under the dung, but they also feed on berries and seeds' (Blanford). Call raucous, somewhat plaintive; 'wilder', easily arresting sportsman's attention (Adams). Flight wild, excited. Noisy, sociable and gregarious; feeding, flying and sometimes breeding in colonies or congregations. Trial of strength not unfrequent, usually between two male birds, when whichever gets the worse of the encounter has the ill luck of being molested with extra pecks of a Jungle-crow. Flocks circle at immense height, then with closed wings down come the birds, one after another in swift slanting swoop. Not wary; observed in higher altitudes to come and roost under the eaves of the houses. Nest-construction begins in March; eggs not unusual in April, and young noticed in the first week of May. The nest is built of twigs, with wool lining, and placed in clefts of rocks; but in Tibet frequently in Tibetan houses, sometimes in holes in the walls only a few feet from the ground, usually the same site being occupied year after year. Osmaston records nests built in small holes excavated in sandstone cliffs by the birds themselves, about 2 to 4 ft. deep; consisting entirely of a thick pad of hair with no substratum of sticks. Eggs usually 3 or 4 in number constituting a clutch, are 'like those of the English birds, but much duller and brownish in tint and they average much bigger, 41.7×28.4 mm. against 40.7×27.9 mm.' (Stuart Baker). The maxima, recorded by Mr. Frank Ludlow, of 17 eggs (*Ibis* 1928, p. 54) are 48.5×27.5 and 47.5×29.25 mm.

50, KAILAS BOSE STREET,

CALCUTTA,

August 28, 1930.

SATYA CHURN LAW,

M.A., Ph.D., F.Z.S., M.B.O.U.,

Honorary Correspondent of Zoological
Survey of India.

XVI.—NOTES ON THE FAUNA OF BRITISH INDIA :
BIRDS, CHIEFLY WITH REFERENCE TO THE
CENTRAL PROVINCES.

411. **Southern Red-whiskered Bulbul.** *Otocompsa emeria fuscicaudata*: In the Central Provinces this bird is more addicted to forests than the vicinity of gardens and cultivation. I have only met with it in the former.

433. **The White-browed Bulbul.** *Pycnonotus luteolus*: Stated to be rare or absent throughout the Central Provinces. This is true to some extent but it is rather plentiful at Kamptee where it breeds freely

and whence several nests have been taken. At Nagpur it now and then visits gardens and has been observed breeding as well.

588. The White-throated Ground Thrush. *Geocichla citrina cyanotis*. This bird is resident in the C. P. and has been observed breeding in the districts of Chanda, Balaghat, Chhindwara and Bhandara.

Vol. II, page 175, line 3 from bottom :—'Wing 4.77 to 4.76 mm.' should probably read inches.

617. The Purple Thrush. *Cochoa purpurea*. *Habits*. Four birds whose stomachs I examined had fed largely on small land molluscs.

700. The White-browed Fantail Flycatcher. *Rhipidura aureola aureola*: *Nidification*—line 4 from bottom 'the bottom of the nest is prolonged into a cone and sometimes furnished with a long thin tail of loose scraps of grass.' This is more characteristic of the nests of *R. pectoralis* and I do not think I have ever seen it in *aureola*. *Habits*:—*R. aureola* and *R. pectoralis* feed largely on the Jassids *Idiocerus clypealis*, Leth. and *I. nivcosparsus*, Leth. which adhere to the trunks of mango trees in enormous numbers, and its display with its fan-like tail seems a means for distributing these insects which are snapped up the moment they take to their wings. This genus of *flycatchers* is perhaps the most specialized of the group in this direction.

703. The White-throated Fantail Flycatcher. *Rhipidura a. albicollis*. The distribution of this species is given as 'The Himalayas from Murree to Eastern Assam, Burma, Shan States, Yunnan, Annam, Siam, Cochin China, Hainan and Malay States,' yet a little above we read 'Birds from the southern Punjab, Central Provinces and Chota Nagpur (presumably places where it is not found) are very rusty below, probably because they are all young birds.'

733. The Scarlet Minivet. *Pericrocotus speciosus speciosus*. *Distribution*: Oates in the old edition gave the distribution of this species as practically throughout the Himalayas, East Assam, U. P., Chota Nagpur and Central Provinces as far south as Bastar and Jaypur; but in the new edition its range is limited to the Himalayas, Assam, North of the Brahmaputra and eastwards to Yunnan. It is certainly found in the Central Provinces and it may be a resident. I have secured or observed it in at least four districts (Balaghat, Bastar, Betul and Chhindwara) and Osmaston has observed it in a fifth (Pachmarhi, Hoshangabad District). The latest date recorded is 21st April.

738. The Small Minivet. *Pericrocotus brevirostris brevirostris*. *Vernacular name*: *Raja Lal* is the common Hindi name for this species in Northern India.

744. The Rosy Minivet. *Pericrocotus roseus roseus*. *Distribution*: I have taken two specimens in the Central Provinces at Nagpur, one in December and the other on 2nd April.

1021. The White-beaked Munia. *Uroloncha striata striata*. Extends North in the C. P. as far as Chanda and Bhandara.

1124. The White-capped Bunting. *Emberiza stewarti*. This bird is a winter visitor or straggler to the C. P. I took a specimen on 1-12-1913 at Nagpur.

1133. The Black-headed Bunting. *Emberiza melanocephala*. This bird has also been taken at Nagpur on 20-3-1919.

1339. **The Little Scaly-bellied Green Woodpecker.** *Picus vittatus myrmecophaneus*. This wood-pecker is found sparingly in the Baster State and I have also taken it in the Balaghat District.

1500. **The Rosy-ringed Paroquet.** *Psittacula krameri manillensis*: Among the few skins of this bird in the Museum, one young male has the lower mandible entirely red as in *P. k. borealis*; an adult male has the under-surface of the lower mandible red, but it is dark at the sides. A female has it dusky but not black.

1783. **The Himalayan Grey-headed Fishing Eagle.** *Ichthyophaga humilis plumbeus*. This bird wanders further south than Lucknow in the winter. Specimens were taken by Mr. A. Donald at Kolkaz, Sipnachadi, in the Melghat (Amraoti District) in January 1913. One of these was presented to the Museum.

1819. **The Indian Crested Honey-Buzzard.** *Pernis ptilorhynchus ruficollis*. According to the key for the species of *pernis* on page 165, all birds taken at Nagpur have the black subterminal and medium bands much narrower than the paler bands and would fall under *P. apivorus*. This, however they are not for three specimens have a wing of 400 mm. one of 405 mm. and the largest 421 mm.

1847. **The Indian Green Imperial Pigeon.** *Muscadivora ænea sylvatica*. The Green Imperial Pigeon is found in the Central Provinces in the South Chanda district and in the Bastar State, extending North to Kanhargao and Katori. A female from the Chanda district had a wing of 225 mm. and a male from the Bastar State had a wing of 220 mm. I think I have heard this bird further north either in the Balaghat or Bilaspur district, but am not certain.

1852. **The Emerald Dove.** *Chalcophaps indica indica*. Occurs in the sal forests of the Balaghat district.

1942. **The Aravalli Spur-Fowl.** *Galloperdix spadicea caurina*. The spur-fowls from Asirgarh in the Nimar district are much greyer than the spur-fowls of Chanda and elsewhere and appear to belong to this race or are near it.

2066. **The Yellow-legged Herring-Gull.** *Larus argentatus cachinnans*. I have taken this gull on the Mahanady in the Bilaspur district. *L. brunnicapillus* has also been taken at Nagpur in June.

2120. **The Eastern Golden Plover.** *Pluvialis dominicus fulvus*. I have taken the Eastern Golden Plover on the Mahanady at Chandrapur in the Bilaspur district. They were in a flock of about 30 birds.

2213. **The Smaller Adjutant.** *Leptoptilos javanicus*. The Smaller Adjutant is resident in the Central Provinces where it keeps to the well-watered and thinly populated parts. I have met it in the Nagpur, Balaghat and Bilaspur districts.

2242. **The Lesser Flamingo.** *Phoeniconaias minor*. A specimen was shot on the Ambajheri tank at Nagpur on the 9th June 1912, it was along with a large flock of *Phanicopterus ruber*. In the winter of the same year many of these birds were being hawked about for sale. On 29th June 1925 I also observed a flock of Lesser Flamingos flying over Nagpur.

CENTRAL MUSEUM,
NAGPUR.

E. A. D'ABREU, F. Z. S.,
Curator.

XVII.—A 'FLYING' FROG.

(With a plate)

The following notes relate to a specimen captured at Ernakulam, in Cochin State, on the night of the 11th June, 1930. It was found adhering to a wet towel, which was hung up in an open verandah for drying. When caught, in the words of the captor, it 'flew' towards the floor, where it was neatly bagged. It was kept in confinement for nearly three weeks, when it was killed, as it was felt that no useful purpose would be served by keeping it alive any longer. During the whole period of confinement it starved, though dragon-flies and other insects were supplied to it at different times.

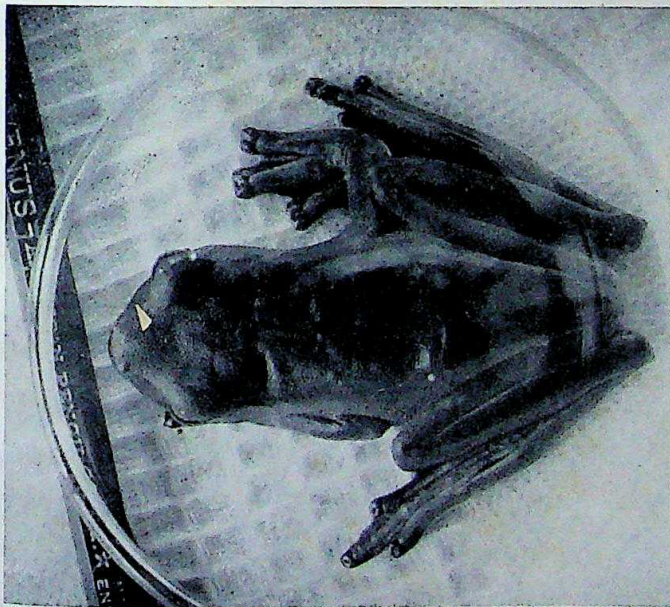
Description.—Upper surface finely granulate; under-surface of the body and snout coarsely so. The lower surface of the thigh also coarsely granulate, but, here, there are some larger granules scattered among the smaller ones.

Heel possesses a dermal appendage, which, when the limb is stretched, is nearly triangular. Snout more or less rounded, and only half as long as the diameter of the orbit. Canthus rostralis somewhat acute, with a lozenge-shaped black spot at the bottom of it. Loreal region concave. Nostril nearer the end of the snout than the eye. Inter-orbital space broader than the upper eyelid. Tympanum $\frac{5}{7}$ or nearly $\frac{2}{3}$ of the diameter of the eye. Vomerine teeth in two nearly transverse series, and touch the inner front edge of the choanae. Each of the toothed ridges measures 3 mm. in length, and the two are 2 mm. apart.

Fingers and toes webbed to the discs as in *Rh. malabaricus*, but the discs of the fingers are larger than those of the toes. Those of the 2nd to the 4th fingers about the size of the tympanum or very slightly less, that of the 1st finger only about half that size. In the foot the disc of the 3rd toe is the biggest, but even this is not as big as those of fingers 2nd-4th; next in size comes the 5th, then 3rd, 2nd, and 1st in regular order. Sub-articular tubercles well developed. In the hand the 1st digit has one inconspicuous tubercle, the 2nd one conspicuous tubercle, and the 3rd and 4th two large tubercles each. In the foot there is a tubercle internal to the hallux, at its base (probably of a pre-hallux). The 1st and 2nd toes have one tubercle each, the 3rd to the 5th two tubercles each.

The tibio tarsal articulation reaches the nostril as in *Rh. malabaricus*, and as in that species that is a dermal fold of a white colour (colour not mentioned Boulenger's description of *Rh. malabaricus*) along the outer margin of the forearm and tarsus. The fold along the forearm is continued on to the hand to the tip of the outermost digit, just as the tarsal fold is continued on to the foot to the tip of the outermost toe. The latter fold becomes continuous anteriorly with the dermal appendage of the heel. There is, moreover, in my specimen, a similar white fold across the buttock just above the vent. When the frog is in an absolutely resting posture the folds of the two legs become continuous by means of this supra-anal fold.

A "FLYING" FROG.



1. *Rhacophorus malabaricus*, Jerd. (Dorsal view*.)



2. *Rhacophorus malabaricus*, Jerd. (Ventral view.)

* The dark bands on the back were not present in the actual specimen. They were caused by the refraction of the glass dish which was used to cover the animal when photographing.

Colour.—In the living animal the back is of rich leaf-green colour, to harmonize with the foliage in the midst of which it lives in Nature. Sides of the body with a yellowish background speckled with circular green spots of size. Ventral surface light yellow. Sides of the thigh of a deeper yellow. Digits and discs yellow. Outer margins of the outer digits of both the limbs green like the back, so that when the limbs are folded in the resting posture, nothing but green is seen. Even in captivity when leaves were put inside the glass case in which it was imprisoned, it required a very careful examination to detect the animal. The upper-arm nearly yellowish with only a green streak above. In the position of rest this section of the limb is hardly visible. The dermal fold, as already noted, is of a chalky white colour. Upper edge of the post-axial side of the thigh marbled red. Eyes, of a speckled golden hue with a horizontal slit-like pupil, which when the frog is 'sleepy' extends almost from end to end.

In the (forefoot) the ground colour of the web is yellow. Between the three outer digits the yellow is rayed with red. Between the 1st and 2nd digits it is purely yellow, without any red streak at all. In the hind-foot the web when expanded is pinkish, rayed with yellow or light streaks; when folded, the colour becomes deeper, almost red. There is a double ray of greyish blue in the webbing between the two outermost digits.

Measurements—(taken immediately after death).

From snout to vent	...	...	...	2½ inches.
Hand expanded	...	...	...	1.25 sq. cm.
Foot expanded	...	...	...	4.1 sq. cm.
Diameter of orbit	...	...	...	7 mm.
Length of snout	...	...	...	4 mm.
Interorbital space	...	...	...	8 mm.
Breadth of upper eyelid	...	...	...	5 mm.
Diameter of tympanum	...	...	...	5 mm.

Habits.—The man who caught the specimen and brought it to me stated with great wonder that it 'flew' slantingly to the ground. There is no reason to disbelieve his statement, as 'flight' could not have been associated in his mind with an animal like a frog, and there was not the remotest possibility of his having heard of a 'flying frog' before. It must have been a piece of correct observation. Mr. M. O. Parthasarathy Iyengar, who describes a specimen from near Sagar in the Mysore Province (*Records of the Indian Museum*, 1915—vol. xi, 140–142) which he calls *Rh. malabaricus* says he saw it actually flying a distance, roughly, of 30–40 yards. His account is, however, very meagre, and I cannot say with any degree of certainty whether the two specimens belong to the same species. I am in the unfortunate position of A. R. Wallace who described a 'flying frog' for the first time from Borneo. He himself never saw it flying, but was assured by the Chinese workman who brought it to him that he saw it doing so. I have tried various manoeuvres to see my specimen flying, in enclosed rooms, but had to content myself with the spectacle of various kinds of acrobatic feats, except flying.

I dared not take it out into the open, as I found that it was an expert jumper, and feared that in the open it would make good its escape by a few leaps, which would take it out of my reach, and probably out of my sight also, particularly in view of its wonderful protective colouration. It jumps apparently without any effort, and on one occasion, at any rate, its jump was suggestive of flight. When jumping it has the webs fully extended. It was never tired of jumping at any time of its captivity, and in spite of its continued starvation, it would indulge in its gambols if encouraged to do so. If it misses its aim it lands dexterously and is never hurt. It can jump repeatedly from heights which are fatal to ordinary frogs. It is an active and skilful climber as well, climbing up vertical heights with ease and grace. When jumping, with the webs extended and the variegated colours shown to the best advantage, it was a most picturesque object to look at. It naturally, like all cold-blooded animals, likes a little moist surroundings, but does not tolerate water. I put it into the 'frog tank' in my laboratory several times, when it invariably jumped onto the side wall, above the water level. If repeatedly put in water against its will, it gets tired, and then practically floats on water with its limbs and webs stretched out. It is by no means afraid of man, but allows itself to be petted, and sometimes even clings to him in preference to the branches of trees put in its case to give it as nearly as possible its natural surroundings. In captivity it was ordinarily rather sleepy, but I had only to moisten it with a little water, and it at once would wake up, bulge out its eyes dilate its pupils which then became more or less elliptical, and was then intent on mischief. It would take aim at the spectator or keeper and jump on to his face or glasses, if he should wear any, spitefully, it would seem. Its attention could be called by making a tap at the door or window when it jumps towards it. It was one of the most lovely creatures I set my eyes on, which I was indeed loathe to kill. But it consistently refused to take any food, and by the 5th of July when it was killed it had become rather famished and the bulging of the sides of the abdomen had disappeared.

Nevertheless it was even then capable of taking long leaps as before.

There is, I am told by an old gentleman who happened to see it, a popular belief with as much truth about it as in beliefs of that kind, that if by any accident this creature should jump on to the bodies of babies, the waist of the latter would get constricted like its own. The significant point about this legend is that it implies that these frogs have been seen before by common people, though not possibly recorded. I showed the photographs to certain country gentlemen some of whom at once attested to the marvellous leaping power of the animal.

Systematic position.—The first time a 'flying frog' was recorded and described was from Borneo by A. R. Wallace to whom it was brought by a Chinese workman. *Rh. pardalis*, as he calls it, differs from my specimen in several important particulars. Wallace says (*Malay Archipelago*, p. 29) 'the webs were black, rayed with yellow.' The colour of the web of the present specimen is quite different.

Wallace does not mention the mottling of the sides, and from the illustration of the animal given by him in the next page, the sides seem to be of a uniform—probably whitish—colour. The measurements of Wallace have been seriously questioned by Gadow (*Cambridge Natural History*, vol. vii, pp. 246-47) who thinks that Wallace was guilty of a little confusion, which accounts for the exaggerated figures. But the measurements of my specimen, except as regards the total length do not agree with those given even by Gadow. Apart from the distribution which is against the specific identity of the two, there are enough differences pointing to the conclusion that the present specimen is not referable to Wallace's *Rh. pardalis*.

Mr. M. O. Parthasarathy Iyengar has described a 'flying frog' from Sagar in the Western Ghats region of the Mysore Province, which is probably referable to the same species as mine. The description is however meagre, and touches upon only a few points of systematic interest. In general, however, the colour scheme agrees with that of the present specimen although there are differences, e.g., the underside of his specimen is 'bright yellow' while it is only 'pale yellow' in the one under notice. The sides are speckled according to his description with dark brown spots, while in my specimen the spots are green. The measurements of the expanded hand and foot also fairly agree in the two specimens. He identifies his specimen as *Rh. malabaricus*. I have gone through the description of *Rh. malabaricus* given by Boulenger in *The Fauna of British India*, (Reptilia and Batrachia) with which, it must be admitted, my specimen agrees most closely of all species of *Rhacophorus* described therein. I am not satisfied that my specimen belongs to the same species. I give below side by side, in two separate columns the important points of resemblance and difference between *Rh. malabaricus* as described by Boulenger, and my specimen:—

Resemblances

1. Fingers webbed to the discs.
2. Vomerine teeth in two straight series touching the inner front edge of the choanæ.
3. Loreal region concave.
4. Nostril nearer the end of snout than eye.
5. Inter-orbital space broader than upper eyelid.
6. Tympanum 517 or 213 diameter of eye.
7. Sub-articular tubercles well developed.
8. Tibio-tarsal articulation reaches the nostril.
9. Skin finely granular above, more coarsely beneath;

Differences

1. Snout rounded and not sub-acuminate.
2. Snout only half as long and not as long as the diameter of the orbit.
3. Canthus rostralis acute and not obtuse. Moreover there is a black lozenge-shaped spot at bottom.
4. While the discs of the fingers are about the size of the tympanum as in *Rh. malabaricus* those of the toes are much smaller.
5. (i) The colour scheme entirely different with the exception of the green above. The

Resemblances—continued.

- granules under the thigh
intermixed with larger
ones.
10. Outer border of forearm
and tarsus with a dermal
fold.
 11. Heel with triangular
dermal processes.
 12. Green above.
 13. Distribution—Malabar.

Differences—continued.

yellow of the under
surface may fade in
spirit into white, but
even in spirit the
bright colour of the
web especially of the
foot is not lost,
although it diffuses
into a uniform light
pink.

This, if present, in *Rh. mala-
baricus* could not have failed
to be noticed.

- ii. The white of the
dermal fold also is not
mentioned.
- iii. 'The one or two black
spots on either side,
behind the arm' are
not seen in my speci-
men.
6. The dermal fold above the
vent, mentioned for
Rh. maximus but not
for *Rh. malabaricus*.
7. Length only $2\frac{1}{2}$ inches and
not 4". But this may not
be a real difference. It
may only mean that my
specimen is young.

To my mind, at any rate, the differences are sufficiently numerous
and important to entitle my specimen to a distinct specific rank. I
shall not however be dogmatic on this point until I have an oppor-
tunity of examining a type specimen of *Rh. malabaricus*.

References

1. A. R. Wallace ... *The Malay Archipelago*.
2. Gadow ... *Cambridge Natural History*,
vol. vii Amphibia and
Reptiles.
3. G. A. Boulenger ... *Fauna of British India*, vol.
on 'Reptilia and Batrachia'.
4. M. O. Parthasarathy Iyengar. A South Indian Flying Frog—
Rhacophorus malabaricus.
—*Records of the Indian
Museum*, vol. xi, 1915,
pp. 140-42.

MAHARAJA'S COLLEGE,
ERNAKULAM,
October 3, 1930.

K. KARUNAKARAN NAYAR,
Professor of Zoology.

[Professor Nayar's note amplifies the description given by Boulenger in the volume on Reptilia (*Fauna of British India*) particularly in reference to colouration. The specimen referred to was submitted to Dr. Malcolm Smith at the British Museum, who identified it as *Rhacophorus malabaricus* he writes: 'some of the differences quoted by Prof. Nair are not apparent to me and others can be accounted for by individual variation. The only marked difference is the shape of the snout, but it rather looks as if your specimen had banged its nose at some time and spoilt its shape. The difference between the size of the digital discs of the fingers and toe is correct as stated by Prof. Nayar and Boulenger has evidently overlooked this point'. As regards the question of injury to the snout, Prof. Nair has since obtained a second specimen in which the snout is exactly as in the first, i.e., rounded and not sub-acuminate and from which he concludes that the difference in shape indicated by him could not have been due to an accident as suggested by Dr. Malcolm Smith. The second specimen has also been examined by Dr. Malcolm Smith. He writes: 'The snout is certainly flatter than in specimens here, but the tip of the snout in *Rhacophorus* is subject to the same variation as in *Ixalus* and depends, I believe, upon how much of it is absorbed during metamorphosis.

That the Green Tree Frog (*R. malabaricus*) and *R. nigropalmatus* the 'Flying Frog' of Borneo alluded to by Wallace can 'fly' or rather plane, is a well established fact now and probably the same power is given to all the species of *Rhacophorus* with broadly webbed digits. If another specimen can be collected we would suggest that one be allowed to jump from a considerable height—the top of a tree out in the open, if several people are below to catch it again it can hardly escape. EDS.]

XVIII.—ENCOUNTER WITH A HAMADRYAD (*NAIA BUNGARUS*).

On October 1, 1930, I accompanied my clerk to inspect teak tree stumps in Compt. 77, Sinthe Reserve, Yamethin District, Burma. About 8 o'clock in the morning I arrived at a stump which was situated 20 ft. high on the side of a ravine. The top branches of a teak tree had fallen into the ravine and were resting about 3 ft. above the actual bed which was covered with firm but damp sand. Opposite me as I was standing on the top branches was a still smaller ravine, running at almost right angles to the one I was standing in. This smaller ravine went up at a steep angle and had a bed, also, of firm damp sand.

As I found everything in order, I told my clerk to go and hammer up the stump, which was about 40 ft. away from and above me, with my hammer. While this was being done I saw a large snake—about six inches in girth—come down the bed of the little ravine opposite me. At first it did not see me but when it did so, it stopped immediately about 4 yards from me. For about 5 minutes it watched me intently although I had made no movement. At last tiring of this I

told my clerk, who was waiting at the stump for me to move, that there was a large snake in the small ravine and that he was to throw a piece of rock at it. However, as he could not see the snake he threw the piece of rock to me which I picked up. All the time the snake watched me very intently but made no movement whatsoever, its head being an inch off the ground. I, then, threw the piece of rock which, if the snake had not recoiled, would have hit it fair and square. The snake next rose up—its head being some 2 ft. from the ground and its neck distended to about 4 inches in breadth. With a loud hiss, it rapidly advanced towards me. Fortunately, I had with me a thick cane tipped with steel and, as it came at me with extraordinary rapidity, I aimed a blow at its head but missed and caught it a hard blow on the body some 3 ft. behind the head. This caused it to writhe in agony and allowed me to continue to shower blows on it. The snake recoiled and I found time to notice that I had lost six inches off my stick. Then I heard a loud hiss and the snake again came for me. I showered blows on it until my stick broke in 3 pieces, leaving about 14 inches in my hand. As I had no stick I turned and ran up the bank. The snake also turned and followed me for about 10 yards. Fortunately I had so injured it that it could only travel slowly and I was able to pick up a bamboo and kill it outright.

The snake measured 8 ft. 5 inches in length and was marked by bands at every 2 inches. Its general colour was olive green—the bands being a little lighter than the rest of the body. They were by no means distinctive. Very unfortunately I was uninterested at the time and kept no records of it. The Burmans called it 'Nan-than-dwin' or, according to the Burmese Dictionary a 'belted' hamadryad.

PYINMANA,
BURMA,
November, 1930.

P. A. W. HOWE.

XIX.—WEIGHING FISH WITH TWO OR MORE SCALES.

In reply to Capt. Macgregor's interesting account in Vol. XXXIV, No. 3 of the 15th November, I produce for him, and any others, who may care to benefit from it, Thomas's method of weighing fish under similar circumstances from his *Rod in India*, page 38, para. 4.

'When I bought my fishing tackle I thought a spring-balance weighing up to thirty-two pounds was big enough for any man. But one fine day I had the misfortune to catch a Mahseer well over that weight and, of course, I was particularly anxious to know its exact weight. I had in camp two spring-balances, weighing respectively up to twenty-eight pounds and thirty-two pounds. I passed a stout cord through the rings of the two, and suspended them from a bough; then a cord attached to the fish and passed over the two hooks, suspended the fish simultaneously from them both. Reading of the weight indicated by the two instruments and adding them

together, the result was the weight of the fish, forty-six pounds. If neither of the springs, is pulled down beyond its power of springing, the total is bound to be accurate. I have tested it.'

Capt. Macgregor's was an unusual fish, if a Mahseer, though I must admit that before I had finished reading his graphic account, I was convinced it was a *Goonch* (*Bagarus garrelli*) he had hooked.

It certainly had in its fight all the characteristics of a *Goonch*; and if a Mahseer, I can only surmise, must have been schooled by one.

It is an accepted theory that fish attain weight not by age only, but by the size of the stream and environments. The Namhpok Kha may be a small stream and his fish a very old one which would partly account for the sulking and the long drawn-out fight. The teeth or scales, would show this. Capt. Macgregor's theory, couched in humour, of the fish I mentioned, I accept as it is meant, and agree it must have been about 14 lbs.'

There is certainly ample scope for writing a most interesting book on fishing in Burma, but this lot must fall to some member of the Burma Military Police, or the Burma Frontier Service in both of which there are more competent pens than mine and some excellent fishermen with good opportunities. I myself am no longer a resident of Burma, and so out of touch, or I should have gladly tackled the task.

URNA ESTATE, MARHOWRAH P.O.,

A. MACDONALD.

SARAN DIST., BEHAR & ORISSA,

December 30, 1930.

XX.—CANNIBALISM AMONG FISHES.

In a small glass aquarium in my laboratory in which a few fishes were kept, mainly for show, there were two specimens of *Anabas scandens*, three of *Macrones vittatus* and one each, of *Ophiocephalus striatus* and *Saccobranthus fossilis*. They were apparently getting on for some time like 'a happy family', and I never imagined that I was, like the Round Table Conference, confronted with a vexed *minorities* problem. But a tragedy happened two days ago which has very much shaken my equanimity. The only specimen of *Saccobranthus fossilis*, about 6 ins. long, was found last Monday morning when I came to the Laboratory, not only dead, but completely stripped of its flesh, as if orders had been issued to the rest of its *confères* to make a neat skeletal preparation of it. There were marks of injury on one specimen of *Macrones*, in which one of the eyes had been nearly gouged out, on *Ophiocephalus* which had lost a few of its head scales, and on one specimen of *Anabas*, which showed a whitish streak on one side of the base of its dorsal fin. Evidently there was a fight, and *Saccobranthus* did not allow itself to be murdered without a struggle. The act was, no doubt, cowardly on the part of its enemies, but to apportion the blame in just measure to the denizens of the tank is a rather difficult task. *Ophiocephalus* is, I fancy, the chief aggressor. Only about a month ago a small specimen of the same species kept in the tank—which is

well protected—mysteriously disappeared, and I had even then my own suspicion whether his bigger brother was not responsible for his disappearance. This creature, which, in the presence of man, is extremely shy, never takes any food when others are fed. Generally they are given minced frog's meat once a week, when he keeps himself perfectly aloof and has none of it. Pressed by hunger, and probably also prompted by his innate cannibalistic instincts, he must have swallowed his little brother a month ago, and encouraged by the gastronomic effects of that meal he probably attacked *Saccobranchus*, who being in a minority, not only did not receive any help from the rest of the inmates, but was actually harassed by them. *Saccobranchus*, faced with heavy odds, used its formidable spines right and left, and created a certain amount of respect for it, before it was overpowered and killed. And then the cowardly assassins could not apparently think of celebrating their ignominious triumph in a more fitting way than by feasting on the flesh of their erstwhile comrade, and now the lifeless victim of their heinous crime.

MAHARAJA'S COLLEGE,
ERNAKULAM,
January 28, 1931.

K. KARUNAKARAN NAVAR,
Professor of Zoology.

XXI.—EXTENSION OF THE RANGE OF *HIDARI*
BHAWANI, *ELYMNIA* *PEALII*, AND *BHIMA UNDULOSA*.

The following notes on the capture of two species of butterflies and one species of moth may perhaps be of interest as considerably extending the hitherto-known ranges of these insects.

(1) *Hidari bhawani*, DeN. (*Hesperidæ*). One male taken near the town of Toungoo on the Sittang River, Lower Burma, on the 24th August, 1928. I did not see any others. Brigadier-General Evans in his *Identification of Indian Butterflies* gives the Arakan coast as the locality for this species, so this record extends its range a considerable distance eastwards.

(2) *Elymnias pealii*, W. M. (*Satyridæ*). One male taken on the 23rd November, 1929 in a glade in evergreen forest near Kokaung Forest Rest House, which lies about 4 miles west of Namma, a town on the railway about 40 miles S. W. of Myitkyina, Upper Burma. As far as I know, this is the first record of this butterfly from Burma proper, as Brigadier-General Evans only gives it as very rare in Assam and General Tytler records only a few specimens from Manipur and the Naga Hills.

Both the above were kindly identified for me by Captain Riley of the Natural History Museum, South Kensington.

(3) *Bhima undolosa*, Walk. (*Lasiocampidæ*). Two males taken on the 10th November, 1929 in the Kaing Reserve of the Pyinmana Forest Division, Upper Burma. While clearing the boundaries of a teak plantation, I found, on a large *Yon* tree (*Anogeissus acuminata*, Wall.), a grey felted patch of cocoons. This patch was oval in shape and about 3 feet long by 18 inches wide. Some 20 recently emerged

imagines, all males, were still at rest on the patch and I took 8 of these, but later threw away all but two as they had become very greasy. I am told by Mr. Tams of the Natural History Museum, that this is the first record of this moth from Burma and that it may possibly turn out to be a new subspecies. I wish now that I had not been so hasty in discarding most of those I took, but I did not then take much interest in moths and only kept the two specimens as I was rather attracted by their curious shape. I might add for the benefit of others who may have the fortune to find the larvæ or cocoons of this moth, that they are better not touched with the bare hand, as a plainful rash is the result.

c/o A. SCOTT & CO.,
RANGOON,
December 3, 1930.

D. G. CRAWFORD,
Indian Forest Service.

XXII.—CURIOUS BEHAVIOUR OF BUTTERFLIES IN THE INTERIOR OF EXTREMELY DENSE EVERGREEN FOREST.

I do not know whether it would interest your readers to know that butterflies in the interior of an almost impenetrable evergreen forest up here, do not seem to fear man. I was working with a gang of coolies cutting a way into the interior. The butterflies there would come and sit on the coolies and on me. They sat on my hat, my arm, my hand, my putties, and on my boots, sometimes half a dozen at a time. The one sitting on my hand sucked my perspiration with its proboscis and then in spite of my jerking it off from my hand, it would come and sit again on it. This went on for about five minutes when I proceeded onwards to my work. Next day I pointed my finger at a butterfly. It came and sat on it and began to suck my perspiration. Some of these butterflies I saw in Dehra Dun and had to work hard to catch one of them with a net.

CAMP MAKUM JN. P.O.,
UPPER ASSAM.

K. MOHAN LAL, I.F.S.,
Assistant Conservator of Forests,
Dibrugarh Dn.

XXIII.—NOTES ON THE COFFEE LOCUST (*AULARCHES MILIARIS*, LINN.)

This locust is quite common on the island of Salsette, but is more in evidence during the monsoon months when it has reached maturity, as in the dry months it is totally absent till about the end of February. In March I have come across large parties of small 'hoppers' feeding on the leaves of *Heterophragma Roxburghii*, DC. The 'hoppers' though brightly coloured, were sitting with impunity on the upper surface of the leaves. These were no longer than $\frac{3}{4}$ of an inch. When alarmed, they all dropped to the ground and disappeared in the dry leaves. At this stage, as in the adult, they are gregarious. It would be interesting to know whether these parties are always

composed of individuals from the same brood or a combination of others.

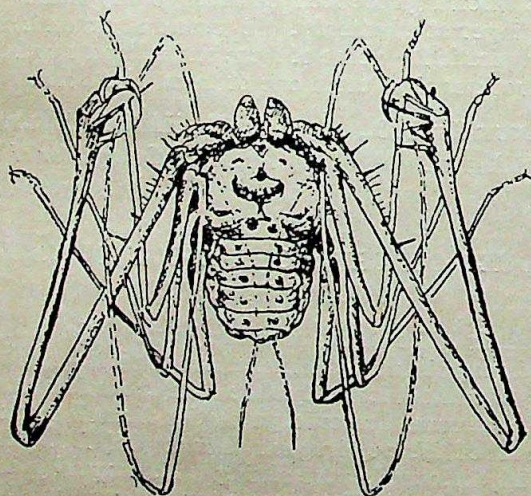
In July the adults are very plentiful. They go about in parties from thirty to fifty (perhaps more) and like the young, sit in the open on the top of foliage. At this period I have observed them feeding on the leaves of *Gloriosa superba*, Linn. In one particular locality I found that all the specimens of this plant in the neighbourhood of such a party were completely eaten barring the stems. When approached and they apprehend danger, they either drop to the ground or fly very lazily to a neighbouring bush. The flight is very heavy and laboured, and usually not prolonged. When caught, they exude a frothy substance from a pore at the base of the jumping legs which soon permeates the surrounding atmosphere. The secretion has a very pungent odour, and in the case of those that I found feeding on *Gloriosa*, it smelt like the crushed leaves of that plant.

It is possibly due to their warning colours and their means of defence, by way of this obnoxious secretion, that these insects are never taken by birds, and it is this that makes them sit in the open with impunity, while other members of their family look for shelter. I do not mean by this that these insects are conscious of their protective colouration, but that habit coupled with the advantage of protective colouring, has made them bolder than their brethren. Such protection is of use to the insect against would-be enemies and not its natural enemies which keep it in check.

BOMBAY NATURAL HISTORY
SOCIETY, BOMBAY,
December 15, 1930.

CHARLES McCANN, F.L.S.

XXIV.—OCCURRENCE OF *PHRYNICHUS PHIPSONI*,
POCOCK, IN SALSETTE ISLAND.



Reproduced from the Fauna Brit. Ind., Arachnidae.

On the 10th of June 1930, I came across a solitary specimen in one of the water cisterns of the Kanari Caves. The cistern was

partially dry at the time, there being a little water here and there after the recent showers of rain. The insect was lurking in a dark corner under the stones. It always adhered to the undersurface of the stones (i.e. with its back to the ground). When first discovered, it was in this position. I touched it to make it move in order to follow its actions. It made off with a sideways movement like a crab and got under another stone. It is also capable of moving forward and backward with considerable speed, but the crab-like movement appears to be the usual method of progression. The two long flagella are kept in constant motion, swinging slowly in all directions, each flagellum keeping in touch with everything in its half circle.

The action of the flagella and the locality inhabited by this curious creature makes me inclined to believe that it adopts 'fishing habits' in obtaining its food. It is possible that with the rise in the level of the water the insect keeps just above the water level with its flat body adpressed to the rocky walls of the cistern, which it resembles, and from this position plays with its flagella on the surface of the water thus attracting 'fish' in the way of aquatic insects and tadpoles (the cisterns abound with tadpoles during the rains) which are speedily taken up out of the water by the chela which are extremely long and seem well adapted to this method of obtaining prey. It must be understood, that I only put this forward as a plausible explanation of the way in which this insect obtains its food and that my theory is not based on actual observation. It is only how matters presented themselves to me at the moment as to the possible use of such long tactile feelers and the extremely long chela.

BOMBAY NATURAL HISTORY
SOCIETY, BOMBAY,
January 20, 1931.

C. McCANN, F.L.S.

PROCEEDINGS

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR ENDING DECEMBER 31, 1930

Administration :

President.—H. E. The Right Hon'ble Sir Frederick Sykes, P.C., G.C.I.E., G.B.E., K.C.B., C.M.G.

Vice-Presidents.—H. H. The Maharao of Cutch, G.C.S.I., G.C.I.E.; Rev. E. Blatter, S.J., Ph.D., F.L.S.; The Hon'ble Sir Ernest Hotson, K.C.S.I., O.B.E., I.C.S.

Executive Committee, Bombay.—Mr. R. D. Bell, C.I.E., I.C.S.; Mr. H. A. W. Brent; Rev. Father J. F. Caius, S.J.; Mr. Alwyn Ezra, F.R.G.S., F.Z.S.; Mr. J. B. Greaves; Prof. V. N. Hate, B.Sc.; Mr. J. G. Rieland; Major S. S. Shey, I.M.S.; Mr. A. Forrington (*Honorary Treasurer*); Sir Reginald Spence, Kt., M.L.C., F.Z.S., Mr. P. M. D. Sanderson, F.Z.S. (*Joint Honorary Secretaries*).

Advisory Committee.—Mr. T. Bainbrigge Fletcher, F.E.S., Pusa; Mr. T. R. Bell, C.I.E., Karwar; Brigadier W. H. Evans, C.I.E., R.E., Quetta; Lt.-Col. F. C. Fraser, I.M.S., Coimbatore; Dr. F. H. Gravely, D.Sc., Madras; Mr. C. M. Inglis, M.B.O.U., F.Z.S., Darjeeling; Mr. R. C. Morris, F.R.G.S., F.Z.S., Coimbatore; Major E. G. Phythian Adams, F.Z.S., Nilgiris; Dr. Baini Prasad, D.Sc., Calcutta; Lt.-Col. R. B. Seymour Sewell, M.A., Sc. D., I.M.S., Calcutta; Mr. H. C. Smith, I.F.S., Maymyo; Lt.-Col. C. H. Stockley, O.B.E., D.S.O., M.C., Meerut.

Staff.—S. H. Prater, M.L.C., C.M.Z.S., Curator; C. McCann, F.L.S., V. S. LaPersonne, M.B.O.U., Asst. Curators.

HONORARY SECRETARY'S REPORT.

The Society's Journal.

The Thirty-fourth Volume of the Society's Journal was commenced during the year. Among the more important scientific contributions were :—

Mr. Pocock's paper on the 'Panthers and Ounces of Asia' in which the sub-species and local races of Asiatic Panthers are dealt with on the lines followed in his previous paper on Tigers. Four new races are recognized and described. The Indian Panther (*Panthera pardus fusca*), according to the author, is very imperfectly known. He believes that there are probably several distinguishable races now grouped under the name of *fusca*, which strictly belongs to a Bengalese type. Series of skins and skulls of Panthers from various parts of India are required for study before any definite conclusions can be arrived at. Members of the Society could help in the solution of the problem by presenting material either to the Society or to the British Museum.

Mr. Pocock in a second paper deals with the 'Lions of Asia'. The author endeavours to settle, as far as the literature and material before him permit, the character and status of the Lions of the Asiatic Continent.

In a paper on the 'Abnormal Tusks of Elephants,' Sir Frank Collyer, of the Royal College of Surgeons, London, discusses the probable causes of the production of multiple tusks in elephants and describes a few specimens which shed light on their etiology. Our thanks are due to Mr. C. R. Pawsey, I.C.S., Deputy Commissioner, Naga Hills, Assam, Mr. R. C. Morris, Mysore, and the Burma Forest School, Pyinmana, for their kindness in supplying examples of pathological ivory for the purpose of this study.

Papers on birds include Mr. P. F. Wickham's 'Birds of the Upper Burma Hills' which was concluded during the current year. The author indicates

that a great deal of ornithological work remains to be done in these hills and that the status of various races of birds occurring in these ranges is but imperfectly known. The paper supplements the information on the birds of the area now available in the new edition of *The Fauna* and corrects certain inaccuracies as regards distribution. The last number of the *Journal* published during the year contained Part I of a paper by Mr. J. K. Standford, M.C., I.C.S., and Dr. C. B. Ticehurst, M.D., M.A., on 'The Birds of the Prome District, Burma', to which further reference is made under 'Expeditions'. A preliminary report on the results of the Vernay Scientific Survey of the Eastern Ghats relative to the birds obtained by the Survey in the Salem District was published under the joint authorship of Messrs. N. B. Kinnear and H. Whistler. The report is the first of a series of papers which are to be published embodying the Scientific Results of the Survey. In his notes on a 'Tour in Further Kashmir', Mr. B. B. Osmaston comments on various species of birds observed during an expedition into the Highlands of Kashmir. In his account of the Ornithological Station at Heligoland, Mr. Salim Ali describes the methods employed in investigating and recording the migration of birds and indicates the need in India for a central organization for ornithological research.

A paper on the 'Monitor Lizards of Burma' by H. C. Smith, gives descriptions and notes on the 5 species of Monitors which occur in Burma. Dr. Baini Prashad gives a list of the Fishes of the Manchar Lake and the surrounding area. Papers of economic interest to Indian fisheries are 'Methods of Fishing in the Punjab,' by M. Hamid Khan and Mr. F. Mitchell's article on the 'Introduction of Trout into Kashmir'.

During the year under review Lt.-Col. F. C. Fraser published Part XXXV of his serial on 'Indian Dragonflies' which contains a description of a new species. A second new species is described by the same author in a separate paper. In his Report on a 'Collection of Ants in the Indian Museum, Calcutta,' Mr. Durgadass Mukerjee includes descriptions of 6 new species. Papers of economic value have been submitted by the Department of Entomology, Indian Lac Research Institute. Messrs. P. S. Negi, M. P. Misra and S. N. Gupta, members of the staff of the Institute, in an article on 'Ants and the Lac Insect' list 8 more species as associated with the lac insect than have hitherto been recorded. The authors are of opinion that ants in general are not injurious to the lac insect and that many of them, especially the Large Black Ant (*Campomotus compressus*) are helpful. The same authors contributed a paper on the 'Noctuid Moth' (*Eublemma amabilis*) which does more injury to lac than any other single predator or parasite of the lac insect. The paper gives a detailed description of the larval, pupal and imago stages of the moth and an account of its life history and concludes with physical and chemical measures to be adopted in its control. In his paper on the 'Aphidæ of Mysore,' Mr. B. Krishnamurthi makes a further contribution to the knowledge of the Aphidæ of Mysore, records notes on common forms and includes descriptions of 6 new species by F. V. Theobald of the Agricultural College, Wye, Kent. Mr. C. E. Fellows-Manson supplements Preston Clark's 'Description of two new species of Sphingidæ of the Oriental Region' with notes on the distribution, etc., of these species.

Botanical papers include the Rev. Fr. Blatter's 'Revision of the Flora of the Bombay Presidency' of which Parts XI, XII and XIII were published during the period under review. In his series of articles on the 'Flowering of Bamboos', which were concluded, Fr. Blatter discusses problems connected with the periodic flowering of these plants. His paper forms a comprehensive review of what has been ascertained so far on this complex subject. Other botanical contributions include 'Notes on the flowering and vegetative growth of Aroids,' by C. McCann, and a paper on the 'Fresh Water Algae of Manipur, Assam,' by K. P. Biswas.

We were fortunate in being able to publish during the year Major G. Covell's paper on the 'Malaria Problem in Bombay,' based on the results of his recent survey. The paper supplements and brings up-to-date the previous investigations of Liston and Bentley into a problem which seriously affects the health of this city.

In a separate class is Mr. Waite's interesting paper on the 'Origin of Continents and Oceans' which has been described as a most lucid exposition of Wegener's celebrated theory of the evolution of the present configuration of land

and sea on this planet—a theory of remarkable interest to Biologists and Palæontologists, offering as it does, an explanation of the reason for the widely different character of the fauna of areas now separated by narrow insignificant straits—a condition particularly evident in the differing faunal regions of South-East Asia and Australia. The importance of environment and isolation in directing evolution along a more or less definite line is being increasingly appreciated. We were glad therefore to be able to publish Dr. Hora's interesting address before the Section of Zoology at the Seventeenth Indian Science Congress on the subject of the 'Value of Field Observation in the Study of Organic Evolution'. Dr. Hora bases his paper on his study of the modifications undergone by the Fauna of torrential streams. The author, while not under-rating other avenues of investigation, professes his belief that the most effective method of interpreting the why and the wherefore of organic evolution is by direct observation of the organism in its environment. The Zoological Survey of India, of which the author is a member, has always considered Field Research as an important part of the duties of the staff. That the policy of extensive field-work has been effectively pursued in recent years is indicated in the series of articles we published during the year on the History and Progress of the Zoological Survey of India. Besides indicating the manifold activities of the Survey, our object in publishing these articles has been to stimulate the interest of our members in the premier Zoological Research Centre in the East and to show how the work of this Institution can be helped by the efforts of laymen.

While scientific contributions form an essential and important feature of the journal, the Editors have endeavoured to identify the publication with one of the main objects of the Society, namely the popularizing of Natural History in all its branches. Popular articles, attractively illustrated in colour and in black and white, have continued to form a distinctive feature of the *Journal*. The issuing of 3 coloured illustrations with each number is no small item of expenditure but the *Journal* is the principal advantage of Membership and the Committee is doing all that it can to increase its value and attractiveness to Members. We are confident that in return members will help by making the *Journal* better known among their friends and thereby increase our membership. The serial on 'Beautiful Indian Trees' of which Parts III, IV and V were published during the year is an especially welcome feature. It is the first attempt to issue a really well-illustrated series of articles on the more conspicuous Flowering Trees of India and the thanks of the Society are due to authors, the Rev. Fr. Blatter and Mr. W. S. Millard. We hope eventually to issue the serial in book-form.

Mr. Stuart Baker continued his interesting serial on 'Indian Wading Birds'. His articles have been a feature of our *Journal* for many years and the Society is deeply indebted to him for his unfailing help in adding to the interest and attractiveness of its pages. His untiring labours and his manifold contributions to Indian Ornithology, deserve the thanks and appreciation of all Ornithologists and laymen. Mr. H. Whistler's serial on the 'Study of Indian Birds' was continued during the year. It is intended as a guide to all those who wish to take up this fascinating study. The author's skilful treatment of his subject amply fulfils the purpose for which he writes. We must also mention Major Hingston's very readable and charming studies of Indian Insect Life. His constant contributions to the pages of the journal are much appreciated.

Big-Game hunting in India finds its place in this year's publications in Lt.-Col. A. H. E. Mosse's instructive articles on 'The Panther as I have known him' and Mr. Morden's 'Notes on an Expedition after *Ovis poli*'. The author's experience indicates that, provided one has the means and one is able to obtain a permit to enter the country, a hunting trip after *Ovis poli* in the Russian Pamir presents no unusual difficulties and can be a very enjoyable experience. Other popular papers include Major W. B. Trevenen's 'Fishing in the Rivers of the C. P.', in which the author introduces the novice to the attractions, the waters of the Central Provinces hold for the fisherman.

We have again to thank a large number of members who contributed to the Miscellaneous Notes published at the end of each number. They form a very readable feature of the *Journal* and offer an opportunity to every member to contribute to the interest and usefulness of its pages.

PUBLICATIONS.

During the year under review, the following new publications were issued :—
Game Birds of India.—By Stuart Baker, Volume III. Pheasants and Bustard-Quail.—The present volume forms a complement to the two volumes in the series previously published by the Society and has long been awaited by members. The next volume will deal with the Partridges and Quails, but publication must be postponed till at least a good proportion of the money invested in the present volume has been recovered.

Bird Charts.—As indicated in the previous report, the Society was able to issue during the year under review sets of charts illustrating 210 Indian Birds in colour. The charts are intended primarily for the use of Schools and Educational Institutions. They supply a long-felt want, providing as they do illustrations in colour of a large series of Common Birds of the Indian Plains. We can reasonably hope that they will achieve the purpose of familiarizing the children in our Schools with the birds of the country. Although designed for Schools, the Charts would be an acquisition in Messes and Clubs in the mofussil.

Forthcoming Publications.—The Committee sanctioned the publication by the Society of Capt. Bates' Book on '*Bird Life in India*'. The author is well known to the readers of the *Journal*. His well written and beautifully illustrated articles on Indian Bird Life have formed an attractive feature of its pages. Capt. Bates has been remarkably successful with his camera portraits of Indian Birds and his book is profusely illustrated with examples of his fine work. Its low cost should ensure a ready sale. The price to members is Rs. 6-12.

EXPEDITIONS AND EXPLORATIONS.

The Vernay Scientific Expedition to the Eastern Ghats was completed during the year. A preliminary account of this important survey, which the Society owes to the generosity of Mr. A. S. Vernay, was given in our previous report. Mr. LaPersonne who was in charge of the Survey made collections of Birds in the Salem, Trichinopoly, Cuddapah, Kurnool, Godavari and Vizagapatam Districts. The total number of specimens collected number 1,777. The material is being worked out by Mr. N. B. Kinnear and Mr. H. Whistler and a Preliminary Report on the collection was published by them in the *Journal*. The authors record their appreciation of the work done by Mr. LaPersonne and indicate that the Survey has been a great success and that very substantial results are expected from it, as the material now available provides important data in regard to the distribution and status of various species and races of Indian Birds. 1,621 Mammals were collected in the same area by Mr. N. A. Baptista. The material collected by him is of great value as it has been obtained from areas which were not touched by the Mammal Survey.

Survey of the Arrakhan Hills.—In January 1930, Mr. Henricks, an assistant in the Bird Department, was sent to assist Mr. A. R. Villar, Conservator of Forests, Prome District, in a Bird Survey of the Arrakhan Hills. Henricks toured the area between January and April. A collection of 353 birds was obtained. The collection is now being worked out by Dr. C. Ticehurst and a report will be duly published.

Naga Hills.—In January 1930, an expedition was sent on behalf of the American Museum of Natural History, New York, with the object of collecting material for a group of Gibbons, and incidentally obtaining material for a similar group for our own Museum. Special facilities were given to the expedition by the Government of Assam and our party received great assistance from Mr. C. R. Pawsey, Deputy Commissioner of Mokokchung, Naga Hills. The members of the expedition included Mr. C. McCann, Assistant Curator, Mr. K. B. Sawardekar, artist, and Mr. Gilbert Nogueira, modeller. Fifteen skins of Gibbons in all stages of colouration were obtained for the Museum, as well as a fine series of skins of the Capped Langur, (*Semnopithecus pileatus*) and the rare Stump-tailed Monkey (*M. arctoides*). In addition, a number of small mammals and birds were collected. The latter including a good set of skins of the Peacock-Pheasant (*Polyplectron chinquis*). Paintings of the type of country inhabited by Gibbons were made by Mr. Sawardekar and specimens illustrative of the plant-life were collected. The material will be used for a habitat group of Gibbons which it is hoped shortly to erect.

BIRD MIGRATION IN INDIA.

3,000 rings were issued during the year in connection with the Bird Banding Scheme of the Society. Eight recoveries were reported and recorded in the *Journal*. This makes the total number of recoveries thirty-two.

INVESTIGATION INTO TOXICITY OF VENOM
OF INDIAN SCORPIONS.

In connection with the above investigation, we must record our appreciation of the help received during the year from Museums, Government Hospitals and Dispensaries which continued to send numbers of live scorpions from all parts of India. This has enabled Fr. Caius, who has been conducting the investigation, to add considerably to the material available for his present research—Reports of the amount of venom obtained from various species during the present year were published in the *Journal*.

THE PRINCE OF WALES' MUSEUM.

The Trustees of the Museum, in adopting the report of the Sub-Committee which recommended the building of a new wing for the Natural History Section of the Museum, have set aside the sum of two lakhs of rupees towards the cost of the new building. The sum apportioned does not permit the commencement yet of the work of erecting a building which is estimated to cost 5½ lakhs, setting aside the not inconsiderable sum that would be required for its equipment. The fate of the scheme now depends on the support it receives from the general public. Trade depression and the distractions attendant on an acute political upheaval have considerably limited the chances of success of an appeal for money from the public at the present time. It is however gratifying to record that a donation of Rs. 10,000 towards the building fund has been received by the Society from H. H. The Maharaja of Cutch and a donation of Rs. 5,000 from H. H. The Maharaja of Bhavnagar. Our thanks are due to Their Highnesses for this generous support.

Pending the decision of the Trustees in regard to the erection of a new building for the Natural History Section, few additions were made to the existing galleries during the year under report. Work was concentrated mainly on exploration, research and the cataloguing of collections.

A list of the contributions to the Museum from 1st January to 30th September 1930 has already been published in the *Journal* and a supplementary list completing the contributions for the year will shortly be published.

Thanks to the generosity of Mr. F. V. Evans, a Vice-Patron of the Society, the work of preparing wax models of Marine Fishes from local waters was continued during the year. Mr. Evans in addition to paying for the services of the Modeller, also made a donation towards the cost of the show-cases for exhibiting the fine series of models of fishes presented by him. Another benefaction of Mr. Evans is the many valuable books he presented to our library during the year. The thanks of the Society are due to Mr. Evans for the assistance and continuous support he has given so generously to the Museum.

We would also express our grateful appreciation of the help we have received from Mr. A. S. Vernay, Mr. A. R. Villar and Mr. J. K. Stanford who organized important expeditions during the year; to Lt.-Col. R. W. Burton, Lt.-Col. C. H. Stockley and Capt. L. D. W. Hearsey for their fine contributions to the collections; to Mr. Stuart Baker, Mr. H. Whistler, Dr. C. B. Ticehurst, Brigadier W. H. Evans, Rev. Fr. Blatter and the Staff of the British and Indian Museums for their willing help in the identification of specimens submitted to them, and in conclusion we would pay our tribute of thanks to Mr. W. S. Millard for the continuous and valuable work he has done for the Society ever since his retirement to England. He has never failed to respond to the numerous demands we make consistently on his time and attention.

STAFF.

The Committee take this opportunity of placing on record their appreciation of the work done by the Curator, Mr. S. H. Prater, C. M. Z. S., M.L.C., and his staff both scientific and clerical.

REGINALD SPENCE,
P. McD. SANDERSON,
Joint Honorary Secretaries.

March 16, 1931.

THE HONORARY TREASURER'S REPORT.

Revenue Account :

Dealing first of all with the Revenue Account : The figures on the expenses side of this account remain very similar to those which appeared in the 1929 account.

This year's Entrance Fees amount to Rs. 1,620 against Rs. 1,814 in 1929, and subscriptions this year show a reduction of Rs. 1,970 when compared with last year's figure.

The Taxidermy Department shows only a small profit of Rs. 3-13-3 this year as against Rs. 192-14-9 last year. In regard to this I would point out that another man was engaged in this department from April 1930 which has caused the profit to be lower.

It will be seen that the Revenue Account shows a loss of Rs. 667-3-4 as against a loss of Rs. 2,995-14-7 last year.

Publication Account :

After paying the author his profit on the 'Snake Books', the publication account shows that a profit of Rs. 588-5-4 has been made this year on the Society's publications. Last year this figure was only Rs. 115.

Balance Sheet :

The Balance Sheet discloses quite a satisfactory position again this year.

Assets :

The Assets side of the Balance Sheet is self-explanatory except that a note is due in regard to the heading 'Game Books'—a number of these have been sold during the year and there is as a consequence a balance of Rs. 2,356-6-2 to be transferred to the Surplus Assets Account.

Liabilities :

Turning now to the liability side, the Life Membership fees amount to Rs. 46,100 this year as against Rs. 42,600 last year.

Under our Articles we have to maintain Government paper investments up to the total value of our Life Membership fees. It will be seen from the Balance Sheet that our investments amount to Rs. 70,487-8-0 and we have, therefore, complied fully with the requirements of our Articles.

The amount of Rs. 19,448 8-7 shown under the heading 'Donations for Specific Objects Unexpended' is held by the Society as a Trustee.

Surplus Assets :

We have to add to last year's balance the profit on 'Game Book' sales and we have also to deduct the sum of Rs. 2,813-5-1 being the necessary depreciation on our securities and also a small loss on the Revenue Account.

The securities have in no case been written up and the depreciation is merely a routine one to bring our $3\frac{1}{2}$ % Government paper to market value on the 31st December 1930. The net difference, therefore, of the Society's position between last year and this year is a profit of: Rs. 131-6-5.

Last year the loss amounted to Rs. 4,403-7-5.

Membership :

During 1930 we enrolled 81 new members, three old members rejoined us, while 112 resigned. The new members enrolled in 1930 show a decrease of 9 over new members admitted in the year 1929.

Resignations in 1930 were, as already stated, 112 against 125 in 1929. Our total membership on 31st December 1930 was :—

Life Members	...	205
Ordinary Members	...	1,113
Total	...	1,318

A. FORRINGTON,
Honorary Treasurer.

March 14, 1931.

BALANCE SHEET AS AT DECEMBER 31, 1930

We have prepared the above Balance Sheet from the cash book and from information given to us, and have verified the Investments and deposits. In our opinion such Balance Sheet represents a true and correct view of the state of the Society's affairs according to the best of our information and the explanations given to us.

BOMBAY, March 11, 1931.
(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants, Auditors.

(Sd.) A. FORRINGTON,
Honorary Treasurer.

PROCEEDINGS

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REVENUE ACCOUNT FOR THE YEAR ENDED DECEMBER 31, 1930

	RS	A	P	RS	A	P	RS	A	P
To Salaries	19,958	14	0	0	0	0	4,691	15	0
Income Tax	552	12	0	0	0	0	1,620	0	0
Society's Contribution to Provident Fund	1,556	11	0	0	0	0	26,781	13	3
General charges	1,054	15	9	0	0	0	4,066	3	0
Rent	2,436	0	0	0	0	0	4,531	0	9
Printing and Stationery	603	6	6	0	0	0	1,295	4	0
Postage	1,549	33	0	0	0	0	4,796	10	11
Furniture depreciation	200	0	0	0	0	0	270	0	0
Fire Insurance	100	0	0	0	0	0	...	...	...
Audit Fee	250	0	0	0	0	0	...	...	...
Taxidermy	4,661	5	9	0	0	0	...	...	...
Library	632	14	9	0	0	0	...	...	...
Cost of Journals	15,362	5	6	0	0	0	...	...	...
Total	...	...	...	...	...	...	...	...	...
				48,519	2	3	...	...	...
				48,519	2	3	...	...	...
				48,519	2	3	...	...	...

PUBLICATION ACCOUNT FOR THE YEAR ENDED DECEMBER 31, 1930

[illegible]

BOMBAY NATURAL HISTORY SOCIETY

ACCOUNT FOR THE YEAR ENDED DECEMBER 31, 1930, FOR INCOME AND EXPENDITURE OF DONATIONS
FOR 'SPECIFIC PURPOSES'.

	RS	A	P		RS	A	P		RS	A	P
To Expenditure on Survey of Shell Fishery.	859	6	0	By Unexpended balance for Show Cases	7,649	5	5				
" Expenditure on Show Cases, Modeller's salary, etc.	6,744	4	6	" " as per last Account " for Museum	5,000	0	0				
" Balance carried to Balance Sheet	..	..	..	" Building " " " " "	3,767	13	8				
	..	..	..	" Donations for Show Cases, etc.	10,520	0	0				
	..	..	..	" Building Fund	125	0	0				
	..	..	..	" Interest received on Building Fund Donation	..	..	..	
Total ..	..	..	..	Total ..	27,062	3	1		27,062	3	1

BOMBAY, March 11, 1931.

Examined and found correct.

(Sd.) A. F. FERGUSON & CO.,

Chartered Accountants, Auditors

(Sd.) A. FORKINGTON,
Honorary Treasurer.



THE INDIAN RED-WATTLED LAPWING. $\frac{2}{5}$.
Lobivanellus indicus indicus.

THE YELLOW-WATTLED LAPWING. $\frac{2}{5}$.
Lobivanellus malabaricus.

John P. S. & Co. Ltd. London.

JOURNAL
OF THE
Bombay Natural History Society.

OCTOBER, 1931.

VOL. XXXV.

No. 2.

THE GAME BIRDS OF THE INDIAN EMPIRE.

BY

E. C. STUART BAKER, F.Z.S., F.L.S., M.B.O.U., H.F.A.O.U.

VOL. V.

THE WADERS AND OTHER SEMI-SPORTING BIRDS.

PART XV.

(With a colour plate).

Genus: HOPLOPTERUS.

Hoplopterus Bonaparte, Georn. Arcad. Rome, xlix, p. 55 (1831).

Type by mon., *Charadrius spinosus* Linn.

This genus is distinguished by possessing a long, curved spur on the bend of the wing; the wing is rounded, the second primary longest; the tarsus is long, slender and reticulated throughout; there is no hind toe.

HOPLOPTERUS DUVAUCELII.

The Spur-winged Plover.

Charadrius duvaucelii Lesson., Dict. Sci. Nat., Vol. xlii, p. 38, 1826 (named from the same specimen as Wagler) Calcutta.

Charadrius ventralis. Wagler., Syst. Av., n. ii (1827) (Calcutta).

Hoplopterus ventralis. Blanf. and Oates, iv, p. 229.

Vernacular Names.—None recorded.

Description.—Whole crown and full crest to the nape, lores, chin, throat and cheeks black bordered with white; hind neck vinous-grey, passing into light brown on the back, rump, scapulars, inner coverts and inner secondaries; upper tail-coverts white; tail white at the base, black on the terminal half, the outer tail-feathers

narrowly tipped with white; primary coverts and primaries black, the bases of the latter white, this increasing in extent until the central secondaries are pure white; outer lesser wing-coverts black; median and greater coverts white; upper breast almost white, shading into vinous-grey on the sides of the neck and browner-grey on the lower breast; centre of abdomen black; remainder of underparts white.

Colours of soft parts.—Iris dark brown; bill black; legs and feet horny-brown to reddish-black.

Measurements.—Wing 185 to 205 mm.; tail 88 to 94 mm.; tarsus about 64 to 67 mm.; culmen 26 to 28 mm.

Distribution.—Practically the whole of Eastern India as far west as, and including, the Central and United Provinces; Assam, Burma, the Indo-Chinese countries and South China. In the north-west it extends to the foot-hills of Garhwal and Kashmir.

Nidification.—The Spur-winged Plover breeds over the greater part of India during March and April but I have taken eggs in the end of February, whilst Osmaston has taken them on the Narbudda River in early May. These eggs, of course, are all laid so that they may be hatched and the young removed before the floods drown them out but, occasionally, they seem to have a second nest in late September or October when they make use of the higher islands and sandbanks above ordinary floods. Unlike most plovers these birds never breed in colonies; sometimes on large sandbanks or beds of shingle two or three pairs may be found together, though even then the nests are separated as widely as possible. The bird breeds both on the rivers in the plains of India and on small swamps at a considerable elevation in the foot-hills of Garhwal, Kashmir and the Eastern Himalayas. The site selected may be any small island or spit running into the river but the birds undoubtedly prefer shingle to sand and will often deposit their eggs in scrapings made in amongst quite large boulders. Occasionally also they may be found breeding in open marshy lands amongst terns and other birds and I once took a clutch of four eggs in a mustard field, in which the crop stood nearly a couple of feet high. The normal clutch of eggs is four, as with other plovers, but in some of their breeding areas three eggs only seem quite common. They are very like the eggs of the Red-wattled Lapwing but on the whole they are duller and more grey or olive brown in general tone, as well as being rather more long in shape. The ground colour may be any tint of stone-yellow, dull grey-brown or buff, very seldom at all warm or bright. The markings consist of numerous blotches, spots and smudges of blackish with other secondary similar shaped markings of pale lavender and grey. The markings of all kinds are distributed numerously over the whole surface of the egg and it is very rare to see a definite cap or ring. I have one or two clutches in which the blotches are fairly bold but as a rule they seldom contrast strongly with the ground colour. The average of one hundred eggs in 41.1×29.4 mm.; maxima 46.1×30.6 mm. and 42.0×31.7 mm.; minima 38.1×29.0 mm. and 39.0×28.0 mm.

When sitting the bird is undoubtedly shy but at the same time

not so wide awake as either the Red-wattled Lapwing or the Pee-wit, for frequently when wandering slowly along rivers or swamps, I have seen the bird get up from its nest and sneak quietly away. Nor does the cock bird seem to keep a very vigilant watch for intruders, for I have often found a female sitting on the nest without there being any sign of the cock bird watching close by. When disturbed from her nest the female bird does not call until she has got a considerable distance away from it. Incubation I think takes from 22 to 24 days. Three eggs which I found on the third of March had their number increased to four, and all four chicks were hatched on the 28th of the same month. The little birds, although apparently only just hatched, could run with great speed but on being approached and finding escape impossible, lay flat down amongst the small shingle, becoming at once very inconspicuous. When lying thus, they kept their eyes tight shut but after I had stood a few moments watching them, first one eye and then the other eye would open, being promptly closed again when they saw I was watching them. They lay perfectly still until I picked two up, but the other two, which I had been unable to watch closely, immediately scuttled away when unobserved and I was unable to find either. Whilst I was watching them the hen bird kept circling overhead, calling loudly, "Did-he-do-it, did-he-do-it", and was soon joined by the male bird who expressed his indignation in equally emphatic tones.

Habits.—The Spur-winged Plover as a rule keeps either singly or in pairs but I have occasionally seen two or three pairs together, probably attracted by an especially extensive supply of food. In its flight and general actions this plover is very much like the Pee-wit but he keeps more consistently to the banks of rivers and large and small streams. When shooting along these streams the Spur-winged Plover is one of the most annoying birds imaginable, as he not only gives very early notice of one's approach to any big game near enough to hear him but, even after he has done so, insists on accompanying one for a considerable distance up or down the stream, calling loudly every few seconds all the time and many a shot have I missed at big game in consequence of his unwelcome attentions. He flies with very much the same flapping motion as the Pee-wit and is capable of the same speed and activity as that bird on the wing, whilst on the ground he runs with equal celerity. The call is a loud and most persistent "Did-he-do-it, did-he-do-it" generally finishing up with an emphatic, "Yes-he-did". They swim very well and I have seen tiny chicks not more than a few hours old walk deliberately into a rapid stream and swim across to the opposite shore. They feed very largely on such insect life as they find in marsh lands and the edges of streams, and I have examined birds whose stomachs contained nothing but a mass of caddis worms. They will eat small frogs and tadpoles, crabs and crustacea of considerable size and will pursue and catch small fish cut off in pools of water. The flesh of these birds is quite good, as indeed is that of most of our plovers, and I have more than once enjoyed a stew of plover as a welcome change from the eternal Indian chicken.

GENUS: LOBIVANELLUS.

Lobivanellus Gray.—List. Gen. Genera Birds, 2nd ed., p. 84, Sept. 1841. The no. of the P.Z.S. containing this name was not published until October 1841.

Type by orig. desig., *Parra gænsis* Gmelin = *Tringa indica* Bodd.

This and the next two genera are distinguished by having curious fleshy wattles in front of the eye, whilst in this also there is a small hind toe present. The bill is of moderate length, the culmen flattened at the base and the dertrum slightly swollen; the linear nostrils are placed in grooves extending over more than half the length of the upper mandible; the wing is long, with the second primary, longest in both sexes, is furnished a spur at the bend; the tail is almost square; the tarsus is long and reticulated throughout.

GENUS: LOBIVANELLUS.

Key to Subspecies.

- A. A white band down each side of the neck to the breast.
 - a. Slightly darker and with more purple gloss *L.i. indicus*.
 - b. Slightly paler and with less purple gloss *L.i. aigneri*.
- B. A white band from eye to ear-coverts only, lower neck black all round *L.i. atronuchalis*.

LOBIVANELLUS INDICUS INDICUS.

The Indian Red-wattled Lapwing.

Tringa indica Bodd., Pl. Enlum., p. 50 (1783) (Goa).

Sarcogrammus indicus. Bläuf. and Oates, iv, p. 224.

Vernacular Names.—Titiri, Titar, Titi, Tituri (Hind.); Titavi, (Mahr.); Yamapa Chitawa (Tel.); Al-kati (Tam.); Kirala, Kibulla, (Cing.); Balighora, Tata-tua (Assam).

Description.—A broad white band from the eye, including the ear-coverts, passing down the side of the neck and joining the white of the lower breast, abdomen, vent and under tail-coverts; remainder of head, fore-neck and breast glossy black, back, scapulars and innermost secondaries olive bronze-brown, with a purple gloss on the lesser and median wing-coverts; lower back darker brown; rump, upper tail-coverts and tail white, the last with a broad subterminal black bar, the central feathers with brown tips and a brown margin to the black band; primaries and outer secondaries black, the secondaries with broad white bases, which increase until the central rectrices are all white; primary coverts black; greater coverts white with concealed black bases; axillaries white.

Colours of soft parts.—Iris red to red-brown; bill-tip black, the rest red or orange-red; eyelids and wattle crimson-red; legs bright yellow.

Measurements.—Wing 212 to 233 mm.; tail 107 to 116 mm.; tarsus about 79 to 89 mm.; culmen 32 to 34 mm.

Young birds have the black feathers of the head broadly fringed with brown; the chin, throat and fore-neck are white and the sides of the neck not so pure a white as in the adult.

Nestling in down.—Upper parts grizzled grey-brown, white and a little rufous; there are well-marked central and lateral coronal black streaks, a big black patch on both sides of the anterior crown, meeting behind; a well-marked dorsal line and two short black thigh-lines; sides of head and neck white; throat and fore-neck black; remaining underparts dull white.

Distribution.—The whole of India and Ceylon except Sind, Mekran and the Baluchistan frontiers on the west and Assam south of the Brahmapootra and the extreme eastern districts of Bengal, north-east of the Bay of Bengal.

Nidification.—The Red-wattled Lapwing breeds wherever found throughout the Plains and up to an elevation of nearly 5,000 feet, though perhaps not very often above 3,000 feet. Its normal breeding season is March, April and May, but fresh eggs may be found up to August and I have personally taken eggs in the last week of February, and, on several occasions, in March. The favourite nesting site undoubtedly is the bank of some river or an island in the middle of it, though they are not particular as to where they deposit their eggs so long as there is water within easy distance. They breed in almost any kind of open country that is not dry, and very often select a most curious position for their nest. Ballast of railway-lines is quite a popular resort for these birds during the breeding season and Hume records the following:—

“Going along the line at Etawah for about three miles on 14 August, we found five nests, one containing perfectly fresh eggs. Four of these nests were on the kunker ballast within two feet of the rail, so that the foot-board of the carriages of every train must have passed over and within two feet of the sitting bird. The fifth was on the top of the boundary bank, the bird was sitting totally unconcerned as our trolley passed within six or eight feet of it, and only moving when I walked up to the spot. Brooks tells me that along his fifty miles of line he has seen at least one hundred nests within the last twenty days or month.”

The same author records eggs as having been found in an old brick kiln, on the top of hedge banks and even on the top of two-storeyed houses. On the last-named position they hatched their young and in two days had them down in the garden, though how they were transferred from the parapet of the roof, 40 feet from the ground, Hume could not ascertain. Mr. A. Anderson also records an instance of this lapwing breeding on the top of a building, a pair having laid three clutches of eggs between the first week of May and the third week of June. These were, however, all taken, so nothing was discovered as to how the birds take down their young to ground level. Most of the eggs I have found myself have been on sandbanks in rivers and, though they often breed more or less in company with various gulls, terns and other plovers, they seem to prefer sites which are gravelly or rocky, so

that whilst other birds may be found breeding on the sandy shores of the river, the eggs of this plover will be found slightly apart, on the more shingly portions of the bank. The nest consists merely of a depression scraped in the sand or shingle, or of a natural hollow in the rock, while the lining, if any, in such places is only a collection of wind-blown fragments.

On the other hand, I have occasionally found nests in cultivated fields, in which a considerable amount of material had apparently been purposely collected, forming quite a respectable nest.

The eggs are quite typical plovers' in appearance, almost invariably numbering four in a clutch. In shape they are broad, slightly peg-top ovals and in colour much the same as the eggs of the Pee-wit, though I think on the whole they are duller and more profusely marked. The ground colour varies from pale yellowish or reddish stone colour to a comparatively deep reddish buff. Others have a pale olive ground tint or, more rarely, greyish stone. The markings are nearly always deep brown or black, consisting of blotches, smudges, spots and scrawls scattered over the whole surface, sometimes forming a more definite cap at the larger end. Most eggs have also secondary markings of lavender, grey, or pale inky. One clutch in my collection has the ground colour an almost bright buff, whilst the markings are of chestnut.

A hundred eggs average 42.1×29.8 mm.; maxima 45.8×31.0 mm. and 43.4×32.2 mm.; minima 39.3×28.0 mm.

The parent birds are very shy and nearly always sneak quietly off their nests before the intruder can spot them, but in defence of their young or eggs they are very bold, and I have seen them bravely attacking both kites and jungle crows, when these approach too near their nests. Miss Cockburn says that she has known them attack people taking their eggs, while that they will drive away dogs and jackals from the vicinity of their nests. If disturbed suddenly from their nests, the birds will feign illness and attempt to distract the attention of the intruder and, when once their young are hatched, will circle overhead, uttering loud calls and making swoops in their attempt to drive the intruder away.

Habits.—The Red-wattled Lapwing is one of the most common and most widely spread of the Indian *Charadriidæ*, and wherever he is seen, makes himself conspicuous by his loud cry, "Did-he-do-it," or "Pity-to-do-it." When not breeding and not persecuted they are very tame and allow a very close approach but, if at all shot at, they at once become the wildest and most astute of birds. They are fond of perching on little eminences, from which they can look all round and, on the approach of any danger, down go head and tail and they scuttle into safety at a great pace, as a rule not rising into the air until they have gone a considerable distance. The flight, like that of other plovers, is normally slow and flapping, though the bird is capable of great speed and has wonderful powers of twisting about in the air. In former times it used to be a very favourite quarry for the smaller hawks employed by Indian falconers, its extraordinary antics in the air often completely baffling the swift swoops of the falcon.

Its food consists of worms, grubs, insects of all kinds, as well as fresh water mollusca, tiny crayfish, etc. I have seen them feeding on tadpoles and a flight of termites is as great an attraction to these birds as to nearly all others.

It is resident wherever found although it may desert certain parts of the country if there is an unusual drought, whilst in winter it deserts the higher hills for the plains.

LOBIVANELLUS INDICUS AIGNERI.

The Mekran Red-wattled Lapwing.

Sarcogrammus indicus aigneri Laubm., "Falco" Aug. 1913, p. 30 (Mekran).

Sarcogrammus indicus. Blanford and Oates, iv, p. 224 (part).

Vernacular Names.—Tatihar (Mesopotamia).

Description.—This race is slightly paler on the upper parts than the typical form and has less gloss both on the back and on the wings. The differences in colour are, however, very slight and there are exceptional specimens from both Mekran and Mesopotamia with as much bronze-green gloss on the back and purple gloss on the wing-coverts as on any Indian bird.

Colours of soft parts as in the other races.

Measurements.—Wing 221 to 240 mm.; one 213 mm.; culmen 31 to 35 mm. (Ticehurst). In the British Museum series the wing runs from 228 to 240 mm.

Distribution.—Mekran, Sind, the extreme North-west Frontier close to Baluchistan and Afghanistan, roughly the Trans-Indus area. The whole of Mesopotamia and South-west Persia.

Nidification.—This Lapwing breeds throughout its area, from Sind to Northern Irak, depositing its eggs in the usual hollow, either natural or scraped out by the bird itself. Scrope Doig took many nests in Sind between March and the end of July and Mr. K. Eates took a large series between the 17th of April and the third week in June, reporting the bird as an extremely common one along the banks of the Hub river, where on several occasions he found many nests containing four eggs on the same day. Most of the nests are built fairly close either to a river or some other piece of water, but this race of Lapwing does occasionally breed further from water than does its Indian cousin. At the same time its eggs will very seldom be taken in really desert country. In appearance the eggs differ in no respect from those of the preceding bird and the average of 50 eggs is 42.4 x 30.4 mm.

Habits.—There is nothing calling for remark in the habits of this bird. It is not perhaps so restricted to well-watered areas as the Indian bird but does not appear to be found in true desert. Ticehurst says:—

"Throughout the length and breadth of Sind the Red-wattled Lapwing is common and well known to all. Its only essential requirement is fresh water or swamps, or, at least, irrigated fields; hence, wherever there is cultivation, or where some little trickle from a desert spring allows the neighbouring soil to maintain a certain amount of dampness, the inevitable pair or so of

these birds will be found, while round jheels, canals, etc., it is of course common. It is quite resident and not sociable, and I do not ever remember seeing more than could be accounted for by a family party, and each pair is jealous of its own terrain."

LOBIVANELLUS INDICUS ATRONUCHALIS.

The Burmese Red-wattled Lapwing.

Lobivanellus atronuchalis (Blyth), Jerdon, B. of Ind., iii, p. 648 (1864), (Burma).

Sarcogrammus atronuchalis. Blanford and Oates, iv, p. 224.

Vernacular Names. Titidu (Burm.); Dao-duyip (Cachari).

Distribution.—Differs from the two preceding races in having the white line down the side of the neck restricted to a patch on and just behind the ear-coverts, leaving the whole neck black all round; the black neck is divided from the green back by a narrow white or lilac band.

Colours of soft parts as in the other races.

Measurements.—Wing 200 to 221 mm.; culmen 27 to 32 mm.

Distribution.—Assam, south of the Brahmapootra, Tippera, Chittagong, Burma and Malay States to Sumatra and the Indo-Chinese countries.

Nidification.—This race of Red-wattled Lapwing breeds principally during April and May but I have eggs taken as early as the 17th of March and one clutch as late as the 22nd of July, this, probably, being a second laying. The birds breed both on the shores and islands of rivers and in cultivated and fallow fields at some distance therefrom. It nowhere appears to be as common as either of the two preceding birds. It ascends the hills to some height and I have taken its eggs in Gachar on the Kopali stream at an elevation of some 1,500 feet, whilst Harington, Grant and Hopwood took them higher than this in the Bahmo Hills. Normally the nests and eggs are just like those of its cousins but I once found four eggs in a rather unusual place—the footmark of a huge tiger on a sandbank. The size of the tiger's tracks had struck me as so extraordinarily large that I was following them up in the endeavour to get a clean mark to measure and, as I did so, the lapwing jumped up and ran along ahead of me and I found the eggs as described. Another rather curious position from which I once took eggs was the upper surface of a large semi-rotten log that lay on the drift left by a hill stream. In Burma they are said frequently to deposit their eggs on the bare soil of paddy fields from which the rice has already been reaped. The eggs do not, I think, vary in any way from those of the other races except that they are on the whole rather darker, possibly to match the darker soil of Burma on which they are laid.

Thirty-six eggs average 41.5×29.8 mm.; maxima 45.4×30.1 mm. and 45.0×31.1 mm.; minima 40.1×28.4 mm. and 40.4×28.1 mm.

Habits.—The habits of this race differ in no way from those of the others. It is equally noisy and equally a nuisance to sportsmen wandering along the banks of rivers and hoping for bigger game as,

like the Spur-winged Plover, they not only are not content with shouting loudly when first disturbed but continue to follow the sportsman and noisily protest against his presence, for some distance.

The flesh of this bird, as well as of the other races, is quite good eating but it can hardly be called a sporting bird and certainly should not be shot for food unless one is very hard up for a dinner.

Genus: LOBIPLUVIA.

Lobipluvia Bonaparte, Com. Rend. Acad. Sci. Paris, xliii, p. 418 (1856).

Type by mon., *Charadrius malabaricus* Boddaert.

In this genus the bill is more slender than in *Lobivanellus*, whilst the tarsus, which is long and slender, instead of being reticulated throughout, has transverse shields in front. There is no hind toe in this genus. Second primary generally longest in both sexes, first and third subequal. Occasionally the first primary is longest but there appears to be no sexual difference in the shape of the wings.

LOBIPLUVIA MALABARICA.

The Yellow-wattled Lapwing.

Charadrius malabaricus Bodd., Pl. Enlum., p. 53 (Malabar Coast).

Sarciophorus malabaricus. Blanf. and Oates, iv, p. 226.

Vernacular Names.—Zirdi (Hind.); Jithiri (N.-W. Provinces); Chitarwa (Tel.); Al-kati (Tam.).

Description.—Line between wattles on forehead and crown black, surrounded by a whitish line; back, scapulars, wing-coverts and innermost secondaries light brown; upper tail coverts and tail white with a broad black subterminal band, absent on the outermost pair of feathers and represented by two small black patches on the next pair, central tail-feathers with brown tips and brown edge to the black band; primaries black, the first three with white inner halves to the inner webs; outer secondaries white with a black tip, this decreasing until the central secondaries are all white; greater coverts white; primary coverts black; chin and upper throat black; neck all round paler brown than the back, darkening on the breast and with a black line dividing it from the white lower breast, abdomen, flanks and under tail-coverts.

Colours of soft parts.—Iris white to silver-grey or pale lemon-yellow; bill black, the base and gape yellow, or greenish-yellow; legs and feet bright yellow.

Measurements.—Wing 184 to 202 mm.; tail 80 to 89 mm.; tarsus about 55 to 61 mm.; culmen 26 to 28 mm.

Young birds are pale sandy-brown above, narrowly barred with rather darker brown; chin albescent, throat and upper breast pale brown with faint traces of darker brown marks.

Distribution.—All India and Ceylon, as far north-west as Lower Sind but not in Upper Sind or the Trans-Indus area. East it extends as far as Calcutta and Dacca.

Nidification.—The Yellow-wattled Lapwing breeds over the great part of its area during March, April and May, but on the Travancore coast Messrs. Stuart and Bourdillon found eggs from the 3rd March to the 13th August, and in almost equal numbers throughout the whole of this time. I think most birds prefer ploughed fields, muddy shores of lakes, swamps and rivers, or waste lands in which to breed. At the same time, whatever site they may select will always be dry and, even when the bird breeds on the shores of swamps and tanks, it does so on the sun-baked mud, well away from the water. In the South of India it certainly seems often to choose the sites last-named, whilst in Northern India it selects in preference dry uplands. The nest is the usual depression in the soil, either natural, or made by the birds themselves; in most instances no lining at all is present but occasionally a few scraps of grass or leaves may be found in it. Protection in the form of bushes, grass or clods is sometimes sought but very often the eggs are placed absolutely in the open, although from their colouration they are very inconspicuous and difficult to find. The normal colouration of this plover's eggs is very similar to that of the red-wattled lapwings, but there is a very curious erythritic form which seems exclusive to this species. This red type of egg appears to be a most wonderful instance of environmental selection. Along the Malabar Coast, stretching into Travancore, there is a long, comparatively narrow, strip of red laterite soil. Roughly speaking, the soil looks as if composed of broken red brick, the whole surface scattered with tiny to medium-sized nodules of black ironstone. Throughout this area of red laterite, the eggs laid by the Yellow-wattled Lapwing are exactly like the ground upon which they are deposited, that is to say, the ground colour of the egg is anything from pale to deep buff red, whilst the markings consist of the usual dark blackish brown or reddish brown specks and blotches numerous scattered over the whole surface of the egg. When *in situ* in their nest, the eggs are practically invisible.

The discovery of this wonderful breeding ground is due to Mr. J. Stuart. In 1915 whilst searching very successfully for the ordinary form of this bird's eggs on the black soil which covers most of Travancore and Malabar, he obtained on a patch of red laterite a set of eggs of the red form. This he very kindly sent home to me. In the following year he deputed men especially to work the larger area of red laterite, similar to that on which he had obtained the first eggs. The first year neither he nor his men were very successful though the few sets they did find were all of the erythritic type. Mr. Stuart however believed that when his eyes got more accustomed to the curious similarity between the eggs and their surroundings, he would be more successful. Accordingly he and his men persisted in their search in subsequent years and eventually got a magnificent series of these eggs. The birds, he found, were quite as numerous on the red laterite soil as they were in the black surrounding country but, whereas in the latter, practically every egg taken was of the normal dark, earthy type, those obtained on the red laterite were with almost equal constancy of the erythri-

tic type. On the rare occasions on which eggs were found on soil contrasting with their colour, they stood up so conspicuously that it was obvious they must have speedily attracted the attention of vermin passing anywhere close by.

It would appear as if, in this instance, the Yellow-wattled Lapwing had become so common on its normal breeding ground of black soil that some of the birds had been pushed into the red laterite, where they had perforce to breed. At first their eggs must have been regularly destroyed by vermin, but amongst the many eggs laid it is probable that some had a certain amount of reddish tinge which rendered them less conspicuous than the others and they thus escaped destruction. In the course of time, as each generation of birds developed, the eggs of those which were more reddish than the rest would survive in greater proportion and thus, eventually, by gradual elimination, only those would be left which laid eggs sufficiently red to ensure the continuation of its kind. It is an extraordinary fact that prior to Mr. J. Stuart's discovery, the very well-known ornithologist, Mr. J. Davidson had twice obtained erythristic eggs of this bird and, when I wrote to tell him about Mr. Stuart's discovery, he mentioned in his reply that he had found two clutches himself and that in each instance the eggs had been taken from a soil he believed was red laterite, which rendered them almost invisible, but that in each case he had had his attention drawn to the place where they were laid, by the female bird getting up and running away. The number of eggs laid seems to be almost equally often three or four, and that the threes are not incomplete clutches is shown by their frequently being incubated. Two hundred eggs average 36.4×26.9 mm.; maxima 42.8×26.0 mm. and 37.0 by 28.5 mm.; minima 32.0×24.4 mm.

Habits.—The Yellow-wattled Lapwing is essentially a bird of dry open country and even though it is more common on the very wet Malabar Coast than anywhere else, it keeps in that area to the drier and more open districts rather than to the wetter, heavily forested country. Stuart says that it is most numerous in the vicinity of the lakes but that it is always found well away from the muddy shores, whilst in Northern India it is often found at great distance from water, which does not seem to be a necessity to this plover as it is to the Red-wattled Lapwing. Its flight is very similar to that of the latter bird but it does not indulge so often in aerial tricks, though at the beginning of the breeding season it constantly rises into the air and goes through the usual motions beloved of lapwings. Its food is principally insectivorous but it eats practically any small living thing such as worms, grubs, small lizards, frogs, etc. Its flesh is quite good eating but, though it is a shy bird in some parts and might take a little care before a sportsman could approach within shot, it certainly cannot be considered a game bird.

Genus: MICROSARCOPS.

Microsarcops Sharpe, Cat. B.M., p. 133 (1896).
Type by mon., *Pluvianus cinerea* Blyth.

This genus is very close to the preceding but has a small hind toe. There is a lappet as in that genus and the long, slender tarsi are reticulated behind and scutellated in front.

The genus contains but one species which summers from Mongolia to Japan, migrating as far as India in the cold weather.

MICROSARCOPS CINEREUS.

The Grey-headed Lapwing.

Pluvianus cinereus Blyth, J.A.S.B., xl, p. 587 (1842) (Calcutta); Blanford and Oates, iv, p. 228.

Vernacular Names.—None recorded.

Description.—Upper plumage from forehead to lower back light brown, the forehead almost or quite pure grey and the head to the nape washed with grey; wing-coverts edged paler and grayer; rump, upper tail-coverts and tail white, with a broad black subterminal bar, almost disappearing on the outermost feathers and bordered with brown on the central ones; primary coverts and primaries black; greater secondary coverts and secondaries white; chin albescent; whole neck and upper breast ashy-grey, terminating in a broad chocolate-black pectoral band; under wing-coverts, axillaries and under tail-coverts white.

Colours of soft parts.—Iris red; bill yellow with the terminal third black; eyelids and lappets yellow; legs and toes brownish-yellow or yellow; claws black.

Measurements.—Wing 228 to 255 mm.; tail 93 to 112 mm.; tarsus about 75 to 79 mm.; culmen 35 to 39 mm.

Young birds have the head, neck and breast concolorous with the black and want the pectoral band.

Distribution.—Breeding from Central Siberia and North-west China to Japan and Corea; wintering in Southern China, the Indo-Chinese countries, Malay States, Burma and Eastern India. Irby reported it from Oude, probably quite correctly, whilst recently Whistler saw it in Kashmir, so close that, although he did not shoot it, he is positive as to its identity. In Assam and Eastern Bengal it is quite common from November to March and I have shot many in the former Province. It has also occurred in the Andamans.

Nidification.—There is very little on record about the breeding of this Plover. According to Dresser it is said to breed in April, depositing its four eggs in the grass of intersecting ricefields. Two clutches, each of three, in my own collection, were laid, one on the fourth of June in Korea and the other on the fourth of May in Eastern Manchuria. These two clutches and a few others I have seen are indistinguishable from the eggs of the Common Pee-wit, except that they average decidedly smaller, although the bird itself is as big or bigger. Probably, moreover, a larger series would show a much bigger average size. My clutch of eggs taken in Manchuria was said to have been laid in a nest in short coarse grass in a swampy field, whilst the others given to me by Dr. Paul Leverkhuun were deposited in a scratching among the grass on a bit of raised land in a ricefield. One of my clutches is

possibly unusually well marked, having a pale buff ground colour with bold blotchings of dark umber brown, fairly numerous distributed over the whole surface here and there, with smaller secondary markings of inky brown and a few underlying of lavender. The other clutch has a comparatively dark brown ground colour, profusely covered with blotches, spots and smears of brown, one egg again having a considerable number of secondary markings of grey. Dresser describes the eggs as being less pointed than those of the Lapwing but both my clutches are distinctly pointed. Eight eggs average 41.3 by 32.6 mm.; maxima 49.6×34.0 mm.; minima 41.0×30.0 mm.

Habits.—The habits of this Plover seem to be very similar to those of the Common Pee-wit but it is more addicted to swamps, lakesides, ricefields and wet ground generally rather than the higher uplands. In Assam, when we came upon them they were almost invariably in the wet ground round marshes and we occasionally shot one when snipe-shooting. They did not appear to be nearly as wild as most plovers and were not difficult to approach within shot. We never came across them in flocks, generally singly and occasionally in pairs. Their flight was much like that of the pee-wit but perhaps less slow and flapping and rather straighter. Two we ate were very palatable, tasting much the same as Golden Plover. The only cry we heard was a plaintive "Chee-it, chee-it", and even this was very seldom uttered. They arrive in north-eastern India about the middle or end of October and disappear again before the end of March, though I once saw one during the first week of April.

REVISION OF
THE FLORA OF THE BOMBAY PRESIDENCY.

BY

E. BLATTER, S.J., Ph.D., F.L.S.

PART XVI.

(Continued from p. 30 of this volume).

ORCHIDACEÆ.

BY

E. BLATTER & C. McCANN, F.L.S.

(With 8 plates and 6 text figures.)

The key to the genera will be given at the end.

1. OBERONIA Lindl.

Species about 100—Palæotropics.

Cooke mentions 3 species. We add 6 new species and 5 not recorded from the Presidency, before.

Key partly based on Fisher, Fl. Madras.

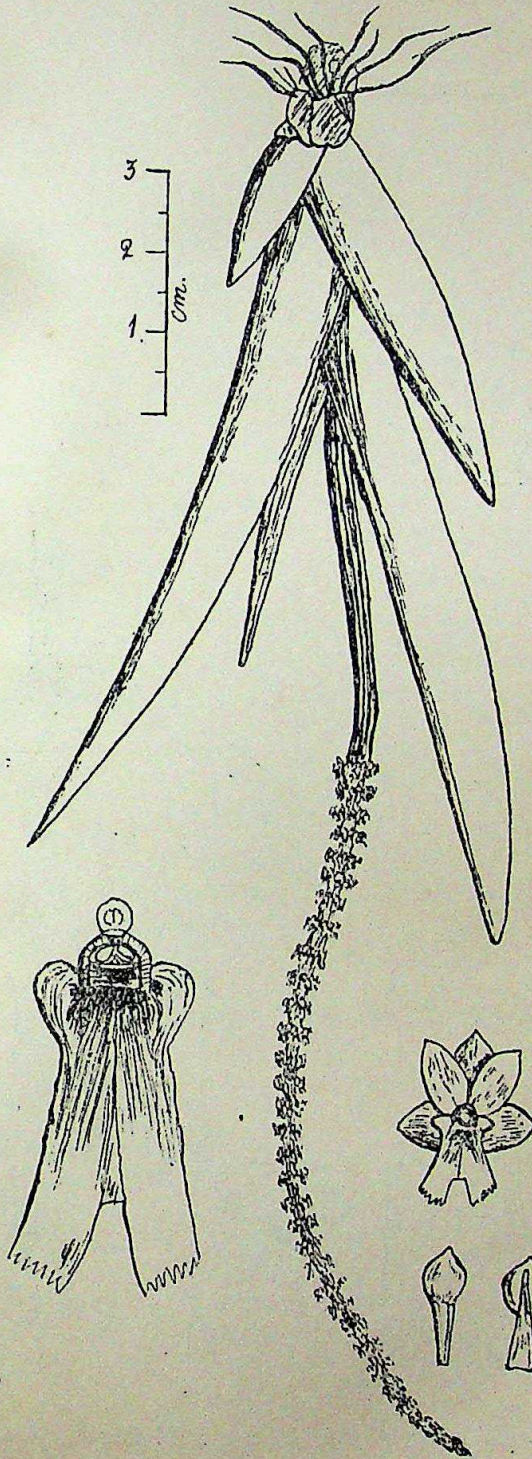
A. Sepals subequal.

I. Petals broad, elliptic-oblong or ovate.

1. Side lobes of lip absent ... 1. *O. verticillata*.
2. Side lobes of lip very small
 - (a) Lip obcordate with 2 triangular truncate slightly diverging lobes, sinus subacute or obtuse; side lobes very minute ... 2. *O. lingmatensis*.
 - (b) Lip oblong, erose, bifid with strap-shaped slightly divergent obliquely truncate segments, sinus $\frac{1}{2}$ the whole lobe; side lobes very small, rounded ... 3. *O. Bellii*.
 - (c) Lip obcordate with subrotund angular divergent lobes and a broad rounded sinus. Side lobes minute. Flowers spirally arranged ... 4. *O. spiralis*.
 - (d) Lip oblong with 2 short narrow acute lobes, separated by a broad sinus; side lobes small, rounded or tooth-like. Flowers not verticillate ... 5. *O. Falconeri*.
 - (e) Lip obcordate, quadrate, 2-lobulate at apex, with a narrow sinus, lobules oblong, dentate at apex; side lobes small, rounded, dentate at apex ... 6. *O. brachyphylla*.
3. Side lobes of lip large, orbicular; midlobe obcordate, 2-lobulate ... 7. *O. recurva*.

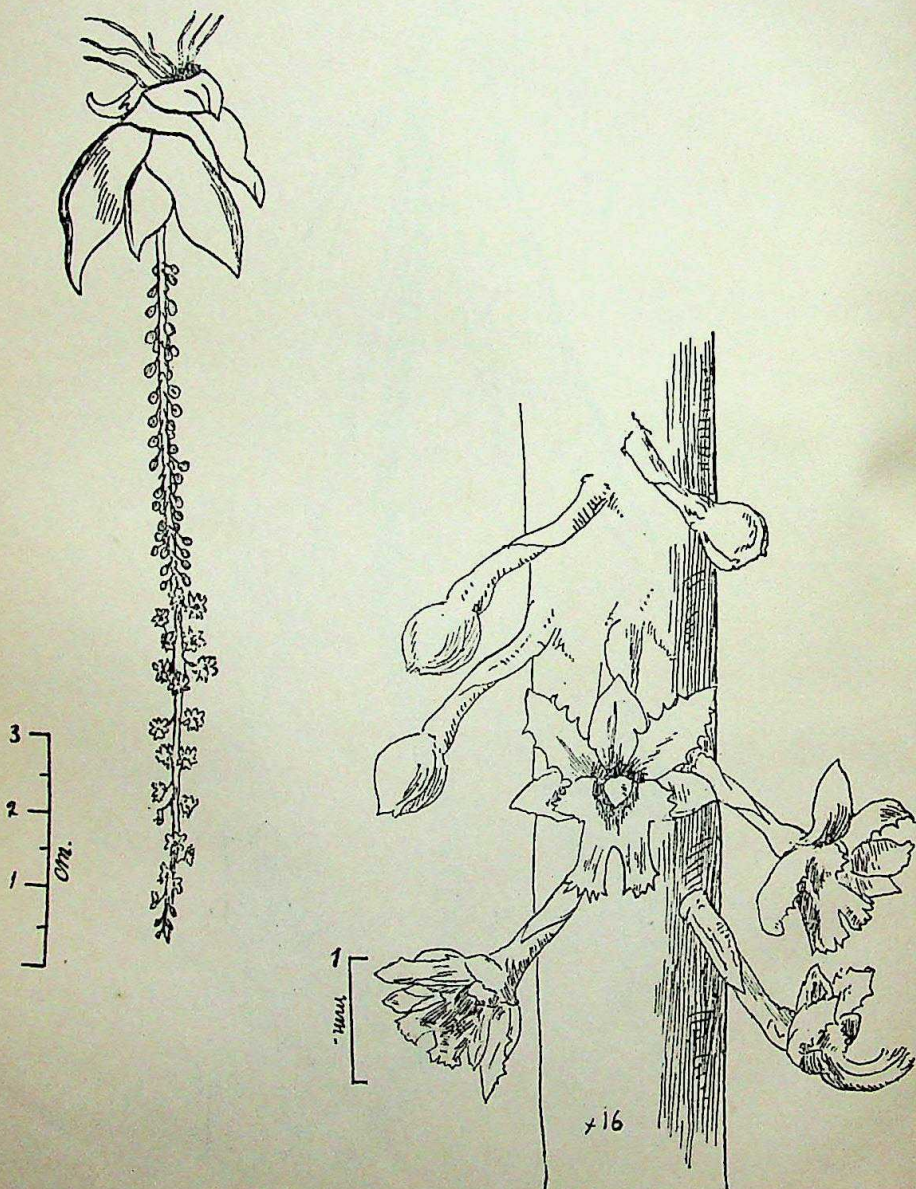
II. Petals linear. Lip distinctly lobed.

1. Scape adnate to the upper leaf.
 - (a) Lip orbicular with a 2-lobed apical auricle. Flowers sessile, densely imbricate; lip with a concave disk ... 8. *O. Brunoniana*.



Del. C. McCann after Miss E. Bell.

Oberonia Bellii, Blatter & McCann, *sp. nov.*



Oberonia brachyphylla, Blatter & McCann, sp. nov.

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- (b) Lip with a short 2-3-fid midlobe; lateral lobes broad, rounded. Flowers sessile, large (5 mm. diam.), densely imbricate ... 9. *O. platycaulon*.
- (c) Lip without side lobes, midlobe ovate-rotund with 2 acute or acuminate parallel processes at the tip, with a more or less narrow and deep sinus 10. *O. Sedgwickii*.
2. Scape not adnate to the upper leaf.
- (a) Midlobe of lip much smaller than the lateral lobes, broad. Lip broadly 3-lobed, crenate, gland-dotted ... 11. *O. Lindleyana*.
- (b) Midlobe of lip much longer than the lateral, narrow
- † Lateral lobes of lip very broad, ovate, obtuse ... 12. *O. Arnottiana*.
- †† Lateral lobes of lip ligulate ... 13. *O. Wightiana*.

B. Sepals very unequal, dorsal ovate-lanceolate, lateral obliquely and broadly ovate-subrotund ...

14. *O. umbonata*.

1. *Oberonia verticillata*, Wight Ic. t. 1626; Lindl. Fol. Orch. Oberon. 3 (excl. *aliquibus* var.); Hook. f. in F.B.I. vi, 678. *Malaxis verticillata* Reichb. f. in Walp. Ann. vi, 211.

This species is not mentioned by Cooke. We give first the description as we find it in the F.B.I. and Wight.

Description: Scape 2.5-5 cm., terete. Leaves 5-10 cm. by 4-8 mm., narrow, ensiform, subfalcate, acute or acuminate. Racemes long, 10-15 cm. long, erect or decurved. Flowers whorled pedicelled, pale yellow (Hooker), 2.5-3 mm. long. Bracts ovate-lanceolate, acute, erose on the margin, about equalling the pedicels. Sepals short, broad, ovate, obtuse, pale green. Petals oblong (Hooker), subobovate (Wight), obtuse, longer than the sepals. Lip twice as long as the sepals, oblong, slightly cordate at base, 2-lobed at apex, lobes broad, roundish, spreading, slightly crenulate on the margin. Ovary pale green. Capsule pedicelled.

We add the following details observed in fresh material:

Scape channelled. Bracts right down to the base amongst the leaves, all scarious. Flowers in whorls of 5, but not exactly at the same height, greenish orange, the base of lip deeper orange above. Column long; anther posticous-terminal, cap green, oval.

In the type the bracts are only as long as the pedicels. This is not the case in a specimen collected by Bell, of which we make a variety:

Var. longibracteata Blatter & McCann var. nov. - *Bractea floribus æquilongae*.

Locality: N. Kanara: Yellapur, 1,500 ft., rainfall 100 in. (Bell 3908! type, 217!).

Flowers: End of September and October.

Distribution of species: W. Ghats of Madras Presidency, Nilgiris, Pulneys, Salem Hills.

2. *Oberonia lingmalensis*¹ Blatter & McCann, sp. nov.

[*Includitur in sectione Oberoniae proprie dictæ. Similis Oberonia verticillatæ* Wight, a qua tamen differt scapo complanato, bracteis lineari-subulatis minime erosis et varicæ longitudinis, floribus longe-pedicellatis, petalis erosis.]

Description: Scape a few mm. long, flattened, adnate to the side of a leaf, with a few hyaline subulate bracts. Leaves many, ensiform, acuminate, falcate or straight, in the same specimen, up to 7-9 cm. by 15 mm., thin. Raceme up to 9 cm. long, 3-4 mm. diam., very dense and uniformly thick throughout, decurved or straight; rhachis slender, channelled. Flowers long-pedicelled, verticillate or subverticillate; pedicels very slender, 2 mm. long including the ovary. Bracts linear-subulate, hyaline, entire, mostly shorter than the pedicel, but also as long or longer than the pedicel, even as long as the whole flower. Lateral

¹ Lingmala is near the Yenna waterfall a few miles from Mahableshwar on the road to Panchgani.

sepals broadly ovate, subacute or obtuse. Dorsal sepal much narrower, subacute. Petals oblong, slightly oblique, erose, slightly longer than the dorsal sepal. Lip obcordate, longer than the sepals, side lobes very minute, midlobe erose, divided into 2 triangular-truncate slightly diverging lobes, sinus subacute or obtuse. Capsule 3-4 mm. long, pedicelled, pedicel about 1.5 mm. long, thickened.

Locality: W. Ghats: Lingmala near Mahableshwar, on trees (Blatter and Hallberg P 1681! type, Sedgwick 7755!, 4626!); Kamelgad, below Fort (Fernandez!).—*Konkan*: Thana forest (Bell 3973!).—*N. Kanara*: In forests (Bell 5406!).

Flowers: February 1918 (N. Kanara); November 1918 (Lingmala); January 1925 (Lingmala); October 1920 (Lingmala). *Fruit*: January 1925 (Lingmala).

3. *Oberonia Bellii* Blatter & McCann, *sp. nov.*

[*Pertinet ad sectionem Oberoniae proprie dictae. Accedit ad Oberoniam verticillatam a qua tamen recedit rhacheis 8-sulcatis, bracteis, lanceolatis fimbriatis aliquantulum genibus longioribus, floribus sessilibus petalis ovato-oblongis, labio oblongo lobo medio bifido eroso segmentis ligulatis apice oblique truncatis.*]

Description: Scape together with raceme almost twice as long as longest leaf. Leaves narrow, ensiform, falcate or subfalcate, acuminate, broad at base, up to 10 by 1 cm. Rhachis fairly stout with 8 grooves and 8 rounded ridges between the grooves. Buds globose, apiculate. Flowers sessile, 2 mm. long, verticillate, one flower on each ridge, the ridge of one node being continued by a groove on the next. Internodes 2.5 mm. long. Bracts 2 mm. long, lanceolate, acute, membranous, broadest in the middle, fimbriate, slightly longer than the buds. Sepals ovate-acute, subequal. Petals narrower than the sepals, ovate-oblong. Lip oblong, longer than the sepals, erose, side lobes very small, rounded, midlobe bifid with strap-shaped, slightly divergent obliquely truncate segments, sinus $\frac{1}{2}$ of the whole lobe. Ovary 1 mm. long. Column merely a horseshoe-shaped low wall, covered by the nearly circular lowly convex green smooth little cap. Pollinia extremely minute, orange-yellow, pear-shaped; point of attachment short and pointed (fixed to a minute surface at each end of horseshoe rim of column).

The pollinia fall out when the flower is ready, the cap raising itself for the purpose. The hollow in the front of the column is square (Bell).

Description and illustration from Bell's MS.

Locality: N. Kanara: Yellapur (T. R. Bell).

Flowers: March 1912.

4. *Oberonia spiralis* Blatter & McCann, *sp. nov.* (non Griff.).

[*Pertinens ad sectionem Oberoniae proprie dictae accedit ad Oberoniam verticillatam Wight, sed differt foliis crassis, floribus interrupto-spiraliter dispositis, bracteis fimbriatis floribus aequilongis vel iis longioribus, labii lobo centrali bilobo sinu lato rotundato intermisso.*]

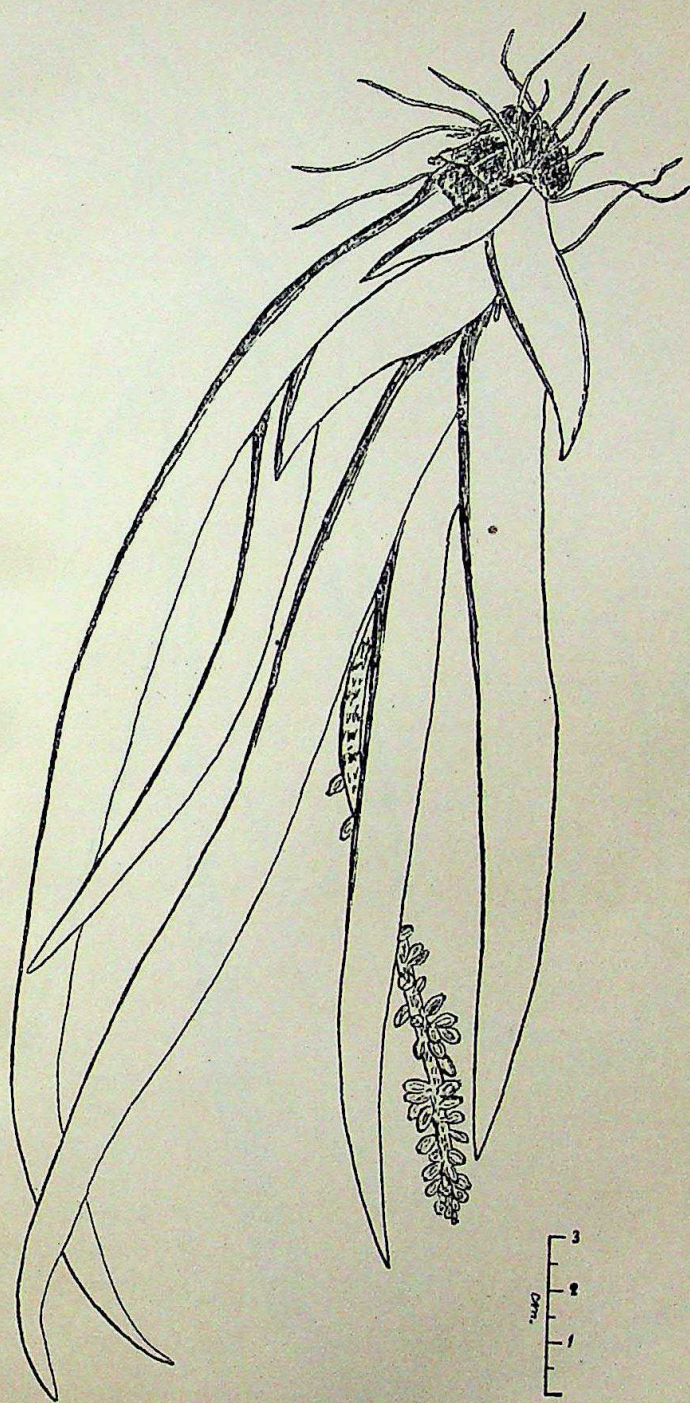
Description: Scape short, terete, lower 2 cm. ebracteate. Leaves few, fleshy, ensiform, straight or subfalcate, 4-6 cm. by 5-8 mm., broad at base or getting slightly narrower, acute at apex. Raceme 13 cm. long, slender, terete. Flowers pedicelled, densely packed on a left-turning spiral, but the spiral regularly interrupted when the flowers have filled $\frac{3}{4}$ of the circumference, windings close to each other, 27 on 10 cm. of rhachis. Pedicels 1-2 mm. long, as long as or longer than the flowers. Bracts narrow lanceolate-acuminate, fimbriate, or obtuse. Petals not linear. Lip longer than the petals, obcordate, with subrotund-angular, divergent lobes and a broad rounded sinus between them; side lobes minute, rounded. Fruit not seen.

Amongst the 'Indeterminable Species' of *Oberonia*, Hook. f. (in F.B.I. v, 686) mentions *O. spiralis* Griff. Notul. iii, 275. As this species wants description and locality and cannot, therefore, be determined, we take it for granted that the name *spiralis* is available.

Locality: N. Kanara: Yellapur, rainfall 100 in. (T. R. Bell 219! type)

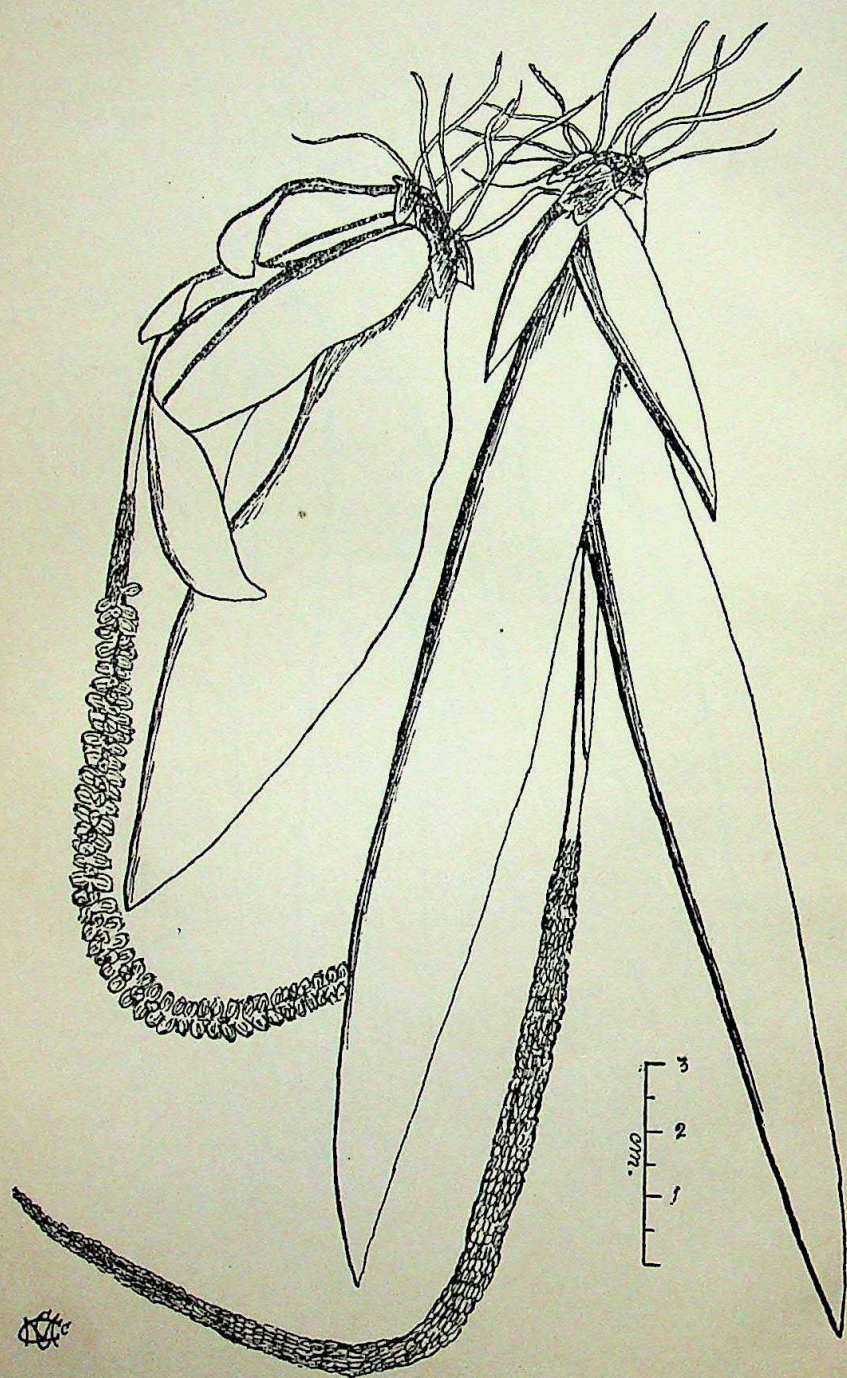
Flowers: October.

5. *Oberonia Falconeri* Hook. f. Ic. Pl. (1888) t. 1780; F.B.I. v, 678; Cke. ii. 676; Duthie Ann. Roy. Bot. Gard. Calc. ix, 2, t. 94.



Del. C. McCann after Miss E. Bell.

Oberonia Brunoniana, Wight.



Oberonia Lindleyana, Wight.

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Description : Cke. l.c.

Locality : Konkan (Law, Woodrow !); Thana (Ryan 65 !); Kalyan (Millard !).

Distribution : Tropical Himalaya, Kumaon, Nepal, Dohra Dun, Behar, Chota Nagpur, Mysore Hills at 3,500 ft., Rampa Hills at 2,000 ft., Vizagapatam Hills at 2,400 ft.

6. *Oberonia brachyphylla* Blatter & McCann, *sp. nov.*

[*Pertinet ad sectionem Oberoniae proprie dictae. Accedit ad Oberoniam recurvam* Lindl. sed distinguitur foliis ovato-oblongis acutis, non glanduloso-punctatis, racemis longioribus laxis, petalis oblongis subacutis, labio quam sepala multo longiore lobo medio quadrato bifido incurvato.]

Description : A small plant, 11 cm. high to top of inflorescence. Scape short. Leaves short, 2.5 cm. long, 1 cm. broad, green, ovate-oblong, acute, nearly straight. Bracts very short, shorter than the pedicel, lanceolate, entire. Raceme up to 9.5 cm. long, lax, slender. Bud ovate or globose. Flowers 1.5 cm. across, long-stalked, 1.25 mm. long, not gland-dotted. Sepals broadly ovate, dorsal, one obtuse, lateral acute. Petals oblong, subobtusate at apex, margin dentate. Lip much longer than the sepals; side lobes small, rounded, dentate at apex; midlobe quadrate, obcordate, 2-lobulate, incurved with a narrow sinus, lobules oblong, dentate at apex. Fruit not seen.

Description after detailed illustrations from live specimens by Mr. T. R. Bell and Miss Bell.

Locality : N. Kanara (T. R. Bell).

7. *Oberonia recurva* Lindl. in Bot. Reg. (1839) Misc. no. 8; Hook. f. Ic. Pl. t. 1784 A; F.B.I. v, 680; King and Pantl. Ann. Roy. Bot. Gard. Calc. viii. t. 9; Cke. ii, 676.—*O. setifera* Lindl. l. c. 3.—*Malaxis setifera et recurva* Reichb. f. in Walp. Ann. vi, 210, 212.

Description : Cke. l. c.

Locality : Konkan (Law).—W. Ghats : Lonavla (Gammie 12678 !, Hallberg 26553 !); Khandala (Law 39); Mahableshwar (Cooke !); Mahableshwar to Pratapgad (Agharkar 2 ! Herb. Calc.).

Distribution : Konkan, W. Ghats, Travancore.

8. *Oberonia Brunoniana* Wight Ic. v (1852) 3, t. 1622; Lindl. Fol. Orch. Oberon. 2; Hook. f. F.B.I. vi, 681; Cke. ii, 677.—*Malaxis Brunoniana* Reichb. f. in Walp. Ann. vi, 209.

Description : Cke. l. c.—According to Fischer, the sepals and lip are dark brownish, the petals pale yellowish.

Locality : Konkan (Dalzell).—N. Kanara : Kalanadi (Ritchie 1405); in forests (Bell 5403 !).

Distribution : Nilgiris, Pulneys, Malabar, Travancore.

9. *Oberonia platycaulon* Wight Ic. t. 1623; Hook. f. in F.B.I. v, 682; Gammie in Journ. Bomb. Nat. Hist. Soc. xvi (1906) 682.—*Malaxis platycaulon* Reichb. f. in Walp. Rep. vi, 239.

Description : Scape very broad, flat, 5-20 mm. broad, very coriaceous, adnate to a leaf to the top. Leaves long, narrowly ensiform, straight, subacute, 15-25 cm. by 12-18 mm. Raceme 7-12 cm. long; rachis stout. Flowers whitish or pale yellow, large, densely imbricate, about 5 mm. across. Bracts broad, sheathing the sessile ovary, erose, acute. Sepals ovate, lanceolate, acute. Petals narrow, slightly shorter than the sepals; lip broader than long; lateral lobes broad, rounded, midlobe very short, bifid or 3-fid. Fruit sessile.

Locality : Western Ghats from the Konkan southwards (ex Hook. f.).

Distribution : Nilgiris, Pulney Hills, High Wavy Mountains.

10. *Oberonia Sedgwickii* Blatter & McCann, *sp. nov.*

[*Pertinet ad sectionem Oberoniae proprie dictae. Accedit ad Oberoniam caulescentem* Lindl. sed differt foliis oblongis vel ovato-oblongis vel lanceolatis acutis multo brevioribus scapo in parte inferiore bialato, bracteis ovatis, floribus non subverticillatis, labio basi minime lobato.]

Description : A very small pedunculous plant, 2-6 cm. high to top of inflorescence. Scape arising from the side of a central leaf, up to 12 mm. long, lower half 2-winged, upper half clothed with hyaline, ovate-acute, erose bracts. Racemes mostly straight, sometimes flexuose, up to 4.5 cm. long, slender.

Flowers short-pedicelled, scattered, densely arranged. Bracts about the length of the pedicels. Sepals gland-dotted. Dorsal sepal broadly triangular-ovate, acute. Lateral sepals obliquely and broadly ovate-acuminate. Petals linear. Lip without side lobes, midlobe broader than lateral sepals, ovate-rotund, with 2 acute or acuminate parallel processes at the tip with a more or less narrow and deep sinus between them. Capsules (perhaps not quite ripe) 3 mm. long; pedicels half as long, stouter than the flowering pedicel.

Locality: W. Ghats: Castle Rock, 1,600 ft., rainfall 250 in. (Sedgwick's collector 5615! type, 5540! co-type).

Flowers and Fruit: March 1919.

11. *Oberonia Lindleyana* Wight Ic. t. 1624; Hook. f. F.B.I. v, 681.—*Malaxis Lindleyana* Reichb. f. in Walp. Rep. vi, 210.

Description: Scape compressed, stout, with raceme 10-18 cm. long. Leaves 7-15 by 1.5-3 cm. very fleshy, ensiform, subfalcate, obtuse or subacute, broad at base. Raceme stout, drooping towards the apex, brick-red, densely covered with innumerable small, sessile, densely imbricating flowers. Bracts broadly ovate-obtuse, subdenticulate on the margins. Petals narrow-linear, entire. Lip broad, rather longer than the sepals, cordate at base, crenate, broadly 3-lobed, midlobe broad, much smaller than the lateral ones, all gland-dotted. Capsule small, sessile on the thickened rachis.

Regarding the colour of the flowers, Wight l.c. says: 'Flowers straw colour, lip dull orange.' According to J. D. Hooker l. c. the flowers are 'pale with an orange (?) centre of lip.' The label in Sedgwick's herbarium bears this remark: 'Spike brick-red'. Sedgwick very likely gave the general colour-impression of the spike.

Wight points out that the very succulent leaves and the long drooping raceme form good marks by which this species can be distinguished.

Locality: N. Kanara: Anmod, 1,200 ft., rainfall 200 in. (Sedgwick 3302 bis!); in forests, rainfall 100 in. (Bell 5402!).

Distribution: N. Kanara, Nilgiris, Travancore Hills.

12. *Oberonia Arnottiana* Wight Ic. 1628.—*O. Wightiana* Lindl. in Bot. Reg. (1839) Misc. no. 9 (*partim*); Hook. f. F.B.I. v, 683 (*partim*); Fischer Fl. Madras pt. 8 (1928) 1407 (*partim*).

We separate this species from *O. Wightiana* Lindl. and in F.B.I. l. c. Hook. f. thinks that *O. Arnottiana* is a longer-pedicelled variety of *O. Wightiana*. The two are certainly nearly allied, but we think that Wight was correct when he said that the ligulate lateral lobes of the lip of *O. Wightiana* is peculiar and at once distinguishes it from *O. Arnottiana*. This latter species can be recognized by long pedicels, by the rounded ovate-obtuse lateral lobes of the lip, by the racemes not drooping, ciliate bracts and acute sepals.

Description: Leaves short, ensiform, subfalcate or straight, succulent, acute. Racemes erect or very slightly inclined towards the apex, scarcely or not at all drooping. Flowers alternate, longish pedicelled, pale green. Bracts ovate-acute, ciliate, somewhat sheathing at the base. Sepals ovate-acute. Petals narrow-linear, about the length of the sepals. Lip cordate at the base, 3-lobed; lateral lobes very broad, ovate, obtuse; midlobe small, prolonged, divided at the apex. Capsules long-pedicelled.

We have avoided giving measures because the specimen at our disposal is evidently a very small form.

Locality: N. Kanara: Anmod, on trees, 2,000 ft., rainfall 200 in. (Sedgwick 3261!).

Distribution: N. Kanara, Nilgiris, Pulneys.

Flowers and fruit: December 1917.

13. *Oberonia Wightiana* Lindl. in Bot. Reg. (1839) Misc. no. 9 (*partim*); Wight Ic. t. 1627; Hook. f. in F. B. I. v, 683 (*partim*); Fischer Fl. Madras pt. 8 (1928) 140 (*partim*).

Description: Leaves broad, ensiform, acute, straight, rarely subfalcate, 2.5-10 cm. by 4-8 mm. Scape and raceme together 7-15 cm. long, curved or decurved; scape terete, naked or sparsely bracteate. Flowers pale green, scattered, short-pedicelled. Bracts broad, ovate or oblong, erose at the apex, longer or shorter than the pedicels. Sepals ovate-obtuse. Petals linear, obtuse. Lip 3-lobed; lateral lobes strap-shaped, embracing the base of the column;

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midlobe prolonged ending in 2 obovate spathulate spreading lobes, crenulate on the margins.

Locality : N. Kanara : Yellapur, hanging on underside of branches, 2,000 ft., rainfall 100 in. (Sedgwick 2483 !); Haliyal, 2,000 ft., rainfall 70 in. (Sedgwick 2863 !).

Distribution : N. Kanara, Nilgiris, Pulneys.

Fruit : May 1917 (Yellapur); August 1917 (Haliyal).

14. *Oberonia umbonata* Blatter & McCann, *sp. nov.*

[*Pertinet ad sectionem Scyllæ. Accedit ad Oberoniam Scyllæ Lindl., sed distinguitur racemis longissimis, bracteis floribus æquilongis vel iis longioribus, sepalo dorsali ovato-lanceolato, petalis oblongis, sepalis lateralibus oblique et late ovato-subrotundis umbonatis, labio lunato.*]

Description : Stem almost 0. Leaves few, up to 6 cm. by 8 mm., straight or subfalcate, thin, linear-lanceolate, acute or acuminate. Scape about 1 cm. long, terete. Raceme up to 13 cm. long, terete, very slender, slightly bent in the upper third. Bracts narrowly lanceolate-subulate, entire (not erose) hyaline, as long as or longer than the flowers. Flowers pedicelled, verticillate, densely arranged. Dorsal sepal ovate-lanceolate, subacute or acuminate, much longer than the lateral sepals, subcucullate. Lateral sepals obliquely and broadly ovate-subrotund, umbonate. Petals oblong, subtriangular and subobtusate at apex, narrower but longer than the lateral sepals. Lip very small, lunate, lateral lobes erect on each side of the column, lanceolate-subulate. Capsules pedicelled, pedicels as long as the capsule.

Locality : N. Kanara : Siddhapur, on a tree, 1,400 ft., rainfall 100 in. (Bell & Sedgwick 7270 !).

Flowers and young fruits in October 1917.

2. *MICROSTYLIS* Nutt. (Cke. ii, 677).

Species 100.—Asia, America.

We retain the one species mentioned by Cooke.

1. *Microstylis versicolor* Lindl. Gen. and Sp. Orchid. (1830) 21 (*non* Wight). Fischer Fl. Madras pt. viii (1928) 1408.—*Microstylis Rheedei* Wight Ic. iii (1843-45) t. 902; Hook. f. F.B.I. v, 690; Ic. Pl. t. 1832.—*Malaxis Rheedei* Heyne ex Wall. Cat. (1828) sub. no. 1939.

Description : Cke. ii, 678.

Locality : Konkan : (Law, Stocks); Hills W. of Mullund (McCann!); Matheran (Chibber!).—W. Ghats: Khandala (Cooke!, Hallberg!, Blatter & McCann 25836!, 25837!); Lonavla (Garade 11!); Mahableshwar (Cooke!); in forest near Lake (McCann!); Koina. Valley below Mahableshwar (Cooke!); Panchgani, Third Tableland (Blatter!); Castle Rock, 1,600 ft., rainfall 250 in. (Sedgwick 2810 bis!).—N. Kanara : Guddehalli on edge of open spaces in the jungle, 1,000 ft., rainfall 120 in. (T. R. Bell 7869 bis!); without locality (Sedgwick 3181 bis!).

A terrestrial herb growing under the shade of trees. Propagation is by two ways, one by seed and the other by budding. The buds may be developed either at the side of the old one or upon the stem or sometimes upon the rachis of the inflorescence. During the dry season the leaves dry up leaving only a stump, but this is only true of plants growing in deciduous forests. Fruits are developed in early October.

Distribution : W. Ghats of Madras Pres. from 6,000 ft. upwards, Chota Nagpur.

3. *LIPARIS* Rich.

Species about 100.—Tropical and temperate regions.

So far, 1 species was known from the Presidency. We add a new one.

- | | | | |
|-------------------|-----|-----|------------------------------|
| 1. Lip 4 mm. long | ... | ... | 1. <i>L. nervosa</i> . |
| 2. Lip 8 mm. long | ... | ... | 2. <i>L. flavo-viridis</i> . |

1. *Liparis nervosa* Lindl. Gen. and Sp. Orchid. (1830) 26; Cke. ii, 678; Fischer Fl. Madras pt. viii (1828) 1410.—*L. paradoxa* Reichb. f. in Walp. Ann. vi (1861) 218; Hook. f. F.B.I. v, 697 and vi, 181; King in Ann. Roy. Bot. Gard. Calc. viii, 27, t. 34.—*L. odorata* Lindl. l. c. 26.—*Malaxis odorata* Willd. Sp. Pl. iv (1805) 91; Grah. Cat. 202.—*L. Dalzellii* Hook. f. F.B.I. v, 698.—*Liparis nervosa* var. *Dalzellii* T. Cooke Fl. Bomb. ii, 679.

Description : Cke. ii, 67.

Locality : Konkan : (Stocks.)—*W. Ghats* : Londa (Spooner !); Castle Rock, very rare, 1,600 ft., rainfall 250 in. (Sedgwick 2792 !).—*N. Kanara* (Law).

Distribution : Kumaon, Nepal, Khasia Hills, 4,000–6,000 ft., Bengal, Konkan, W. Ghats, N. Kanara, Nilgiris, Anamalais at 3,030 ft., Ceylon.—The species may extend further eastwards, but we are not sure.

J. D. Hooker (F.B.I. vi, 181) has this note : 'Mr. Ridley, who finds this species [*L. paradoxa*] at Singapore, informs me that there are two forms; one with pure yellow flowers, the other with the sepals and petals deep blackish purple, and the lip green with purple centre, which latter is the *L. nervosa* Lindl. Gen. and Sp. Orchid. 24.' It is strange that Ridley does not mention *Liparis nervosa* in his Flora of the Malay Peninsula.

2. *Liparis flavo-viridis* Blatter & McCann, *sp. nov.* ; *L. paradoxa* ? Gammie in Jour. Bomb. Nat. Hist. Soc. xvi, 565.

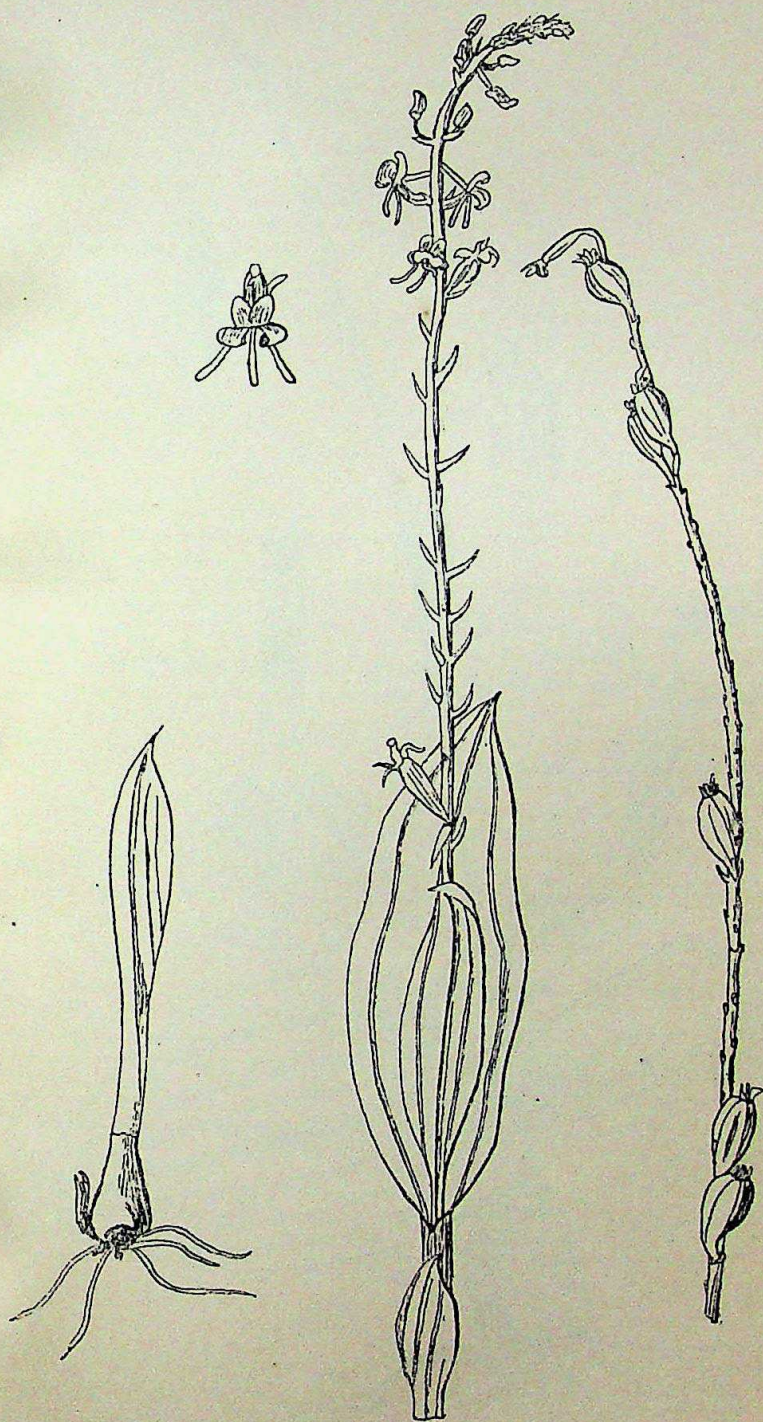
[*Orchidacea sectionis Mollifoliarum accedit ad Liparim nervosam* Lindl. sed distinguitur foliis 5–7-nervosis, bracteis late lanceolatis acuminatis deflexis immo sub anthesi, sepalis valde inequalibus, sepalo dorsali anguste linearis-acuminato, lateralibus obovatis convolutis apice incurvulatis, petalis convolutis sursum curvatis apparenter linearibus vel cylindricis, labio subrotundo apice minutim denticulato emarginato-apiculato, profunde concavo, fructu late oblongo, non clavato.]

Description : Terrestrial herb. Pseudobulbs ovoid or oblong, 5–7 cm. below the surface. Stem thickened at the base and covered by several sheaths. Leaves 2–5, lying more or less flat on the ground, not erect, sessile, alternate, sheathing, up to 14 by 8 cm., ovate or elliptic-lanceolate, subacuminate or acuminate, subplicate; main nerves 5–7, deeply depressed above, very prominent beneath. Scape together with raceme up to 20 cm. long, erect, slender, with scattered bracts. Bracts broadly lanceolate, acuminate, deflexed even at time of flowering, shorter than the somewhat twisted ovary. Buds ovate-oblong, obtuse at apex, not obliquely obovate. Scape, lateral sepals, petals and column light green, lip, anther and cap of column very dark green, floral bracts between the two in shade. Dorsal sepal up to 6 mm. long, narrow lanceolate-acuminate, generally reflexed, leaving the back of the column bare and lying along the ovary. Lateral sepals 5–6 mm. long, straight, convolute, obovate, acute, slightly incurved at apex. Petals slightly longer than the lateral sepals, strongly convolute, appearing linear or rather cylindrical, curved upwards, sticking out together with the lateral sepals under the lip, nearly touching its under-surface with their points. Base of lip in its lower third lying close against and almost parallel to the column with 2 well-developed calli at the very base, calli applied against base of column, of moderate length, conical, rounded at top, very shiny and rugose except at top; limb large, almost orbicular 7 by 8 mm., bent at right angles to the narrowed base, minutely-toothed on the upper margin, emarginate at apex with a minute apiculus, deeply concave, the concavity widening from base of sepal forwards and very shiny along bottom for more than half-way, finely darker-veined, the veins running from the concavity towards the circumference all round, generally simple, sometimes forked. Ovary sessile with slightly winged and thin ridges. Column elongate, stout, inflexed from half-way up, dilated at base. Cap somewhat convex with the hinder lateral slopes, a little flattened before it lifts for the emission of the pollinia, fringed with a thin narrow membrane and minutely rugose laterally. Pollinia 4, without caudicles, in pairs, golden yellow, each pair closely pressed together, the 2 pollinia of each pair of different length, the outer faces convex. Fruit broadly oblong, stalked, 2 cm. by 7 mm.

In bud, the lip embraces the whole column. The pollinia fall out when the cap rises, which happens shortly after the flower opens.

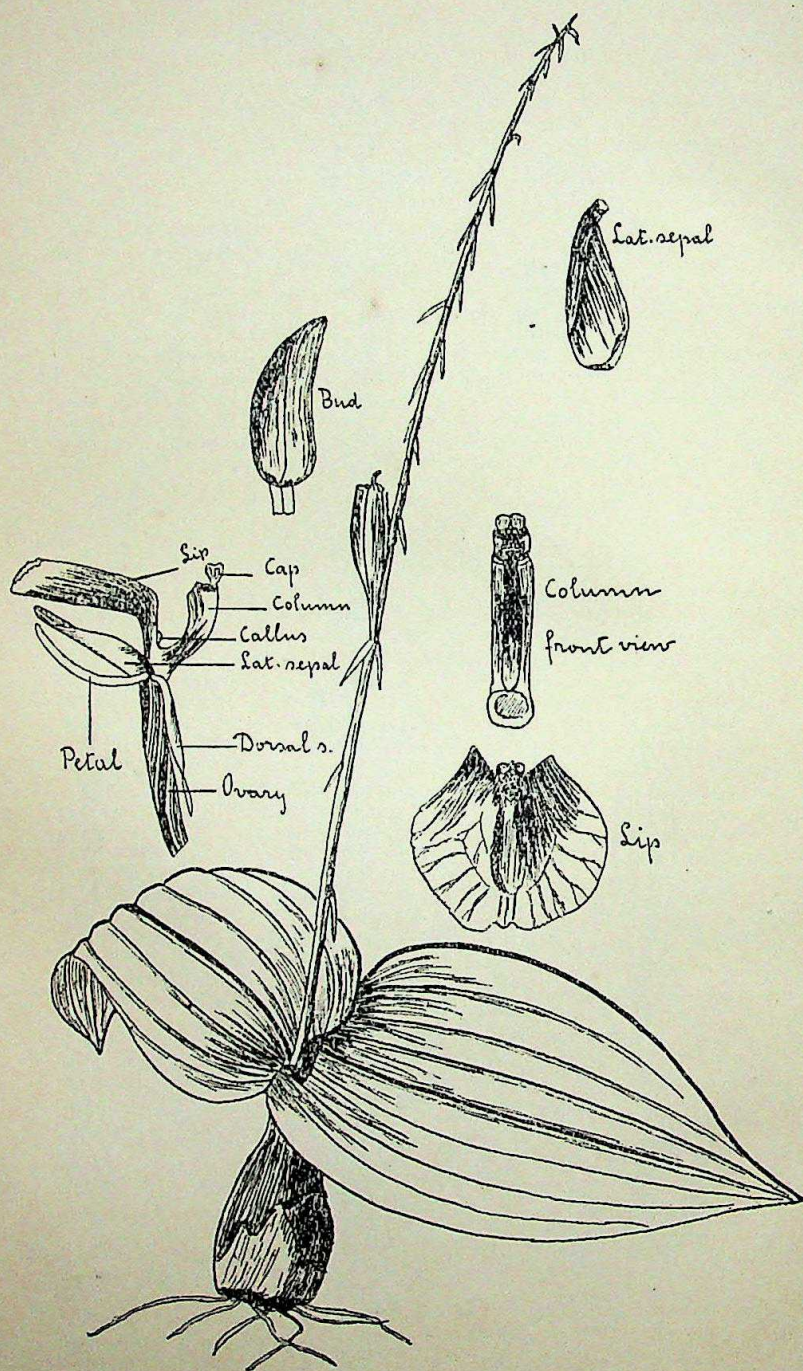
Locality : Mr. T. R. Bell found this orchid in August, 1912, in N. Kanara on the low margin of a tank off the high road from Yellapur to Karwar, on the left-hand side going out from Yellapur, just before the path goes off to Kowdekeri. It was common locally. He found it again in August, 1918, at Dandeli, N. Kanara. It is from this plant that the above description is taken (Bell no. 4217 !).—*S. M. Country* : Londa (several sheets by Spooner in Herb. Econ. Bot. Poona).

Flowers and fruit : August.



Del. C. McCann after Miss E. Bell.

Liparis nervosa, Lindl.



Del. C. McCann partly after Miss E. Bell.

Liparis flavo-viridis, Blatter & McCann, sp. nov.

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4. DENDROBIUM Sw.

Species about 750. Tropical Asia, Japan, Australia, Polynesia.

Of the 8 species mentioned by Cooke *D. Macraei* Lindl. has to be transferred to the genus *Desmotrichum*, the name of *Dendrobium chlorops* has been changed into *D. ovatum* Kränzl. We add 2 other species not contained in Cooke: *D. aqueum* Lindl. and *D. actinomorpha* Blatter & Hallberg.

Note: The *Dendrobiums* have a definite vegetative period. During the monsoons new shoots are formed from the bases of the old ones, full of leaves. At the end of the monsoons the 'new' stems reach maturity and are full of reserve material. After the monsoon the leaves are shed leaving the naked stem. The stem thus developed at the end of one monsoon flower during the cold season, and even into the hot weather. After flowering and fruiting these stems wither away and die. No stem flowers twice. This we have found to be particularly true of Nos. 1, 2, 3, 4. It appears to us that *Dendrobiums* growing in evergreens sometimes flower towards the end of the monsoon as we have observed with No. 7, which we found in flower on the Fitzgerald Ghat, on the 9th October (1930). In this case the superabundant food material probably caused the plants to flower and in such a case the same stem would probably flower again. Evergreen inhabiting plants may deviate somewhat from those found in deciduous forest.

- A. Pseudobulbs short, tufted, with 2 or 3 leaves; or stems elongate and leafy. Flowers in slender terminal or lateral racemes, small or medium-sized; lip often with a flat keel on the disk that ends in a truncate crenate callus on the midlobe.
 - I. Stems simple or nearly so, often a small pseudobulb.
 1. Small plants with crowded ovoid pseudobulbs. Flowers small, in racemes from the top of the pseudobulb; petals not broader than the dorsal sepal. Sepals and petals white.
 - (a) Lip pink with dark-red veins 1. *D. microbulbon.*
 - (b) Lip yellow-green 2. *D. Mabelæ.*
 2. Larger plants; stems tufted. Flowers in terminal and lateral racemes; petals broader than the dorsal sepal.
 - (a) Flowers cream-coloured. Lateral sepals oblong; midlobe of lip subquadrate ... 3. *D. ovatum.*
 - (b) Flowers white, mostly with a tinge of pink. Lateral sepals lanceolate, falcate; midlobe of lip ovate, acute 4. *D. barbatulum.*
 - II. Stems long, copiously branched; flowers small. ... 5. *D. herbaceum.*
- B. Stems elongate, stout or slender, cylindric, clavate or nodose. Flowers in lateral pairs or fascicles or racemes, rarely solitary, usually large, white, yellow, purple or pink.
 - I. Mentum present.
 1. Mentum half as long as the dorsal sepal; lip longer than broad (18 by 12 mm.) ... 6. *D. macrostachyum.*
 2. Mentum less than half as long as the dorsal sepal; lip as broad as long (12 by 12 mm.) ... 7. *D. crepidatum.*
 3. Mentum very short, rotund. Lip much longer than broad (25 by 15 mm.) 8. *D. aqueum.*
 - II. Mentum absent 9. *D. actinomorpha.*

1. *Dendrobium microbulbon* A. Rich. in Ann. Sc. Nat. sér. 2, xv (1841) 19, f. 8; Lindl. in Bot. Reg. (1844) 61; Dalz. & Gibs. Bomb. Fl. 261; Hook. t. F.B.I. v, 716; Cke. ii, 681.—*D. humile* Wight Ic. (1852) t. 1643.—*D. crispum* Dalz. in Hook. Journ. Bot. iv (1852) 111.

Description : Cke. ii, 681.—Add :

Pseudobulbs one on top of the other, often the whole 2-3-pointed, each pear-shaped and, of course, constricted at the junctions, one sheath generally reaching over 2 bulbs, 16 mm. long, longitudinally ribbed, light green coloured, embracing the whole bulb at base. Leaves often purple-spotted and marked above with irregularly impressed veins, longitudinally above and simply pointed below. Flowers 16 mm. long, 12 mm. broad. Bracts straw-coloured, longitudinally veined, up to 4 mm. long. Dorsal sepal 9 by 3 mm., lateral ones up to 8 mm. long, 3 mm. broad at middle. Petals 9 mm. or less, apiculate (Cooke has obtuse). Lip 6 mm. long, 4 mm. broad, broadest at end, 6 mm. broad when spread out, often green with red veins and edges. Cap square, cordate, 0.5 mm. broad. Pollinia 0.25 mm. long (Bell MS.).

Kränzlin points out that in the lip of the live flower there are tender hyaline papillae which disappear very soon and cannot be seen in dried specimens. When, however, the dry flower is boiled, the margin of the papillose lip appears to be what we call 'crenulate'.

Locality : Konkan : (Stocks) ; Thana forests (T. R. Bell 3842 !).—*W. Ghats* : Mahableshwar, 4,500 ft. (Cooke !, Sedgwick 7324 !, Ezekiel 26568 !, Millard 25821 !, Chibber !, Fernandez !).—*S. M. Country* : Deciduous forests S.-W. of Dharwar, 1,800 ft., rainfall 40 in. (Sedgwick 3788 !); Amboli Ghats (Bell !).—*N. Kanara* : (T. R. Bell 4359 !).

Distribution : Nilgiris, Anamalais.

Flowers : January 1929 (Amboli Ghat) ; February 1918 (Thana) ; March 1917, 1918 and 1920 (Mahableshwar) ; April 1918 (Mahableshwar) ; September 1918 (N. Kanara) ; December 1918 (Dharwar).

2. *Dendrobium Mabelae* Gammie in *Journ. Bomb. Nat. Hist. Soc.* xvi (1905) 567 ; Cke. ii, 681 ; Kränzlin in Engl. Pflanzenr. iv, 50, ii, B 21 (1910) 80.

Description : Cke. l.c.—Add : Whole flower dead white except extremity of column outside with a green tip. Column like that of *D. microbulbon*, but stigma comparatively longer. Front of cap quite straight and long (Bell MS.).

Locality : *W. Ghats* : Foot of Fitzgerald Ghat (Fernandez !); Castle Rock, on *Phyllanthus emblica*, 1,600 ft., rainfall 250 in. (Sedgwick 2855 !, 5541 !); Castle Rock (Bhiva !, Gammie 15782 !); Londa (Bhiva !); Belgaum Ghats (Gammie !); Panchgani (McCann !).—*N. Kanara* : Anmod, on the smaller branches of trees (Sedgwick 3370 !); Tinai Ghat, on small trees, especially on *Phyllanthus emblica*, 1,800 ft., rainfall 150 in. (Sedgwick 3197 !, Gammie 15802 !).

Distribution : Apparently endemic.

Flowered at Panchgani at end of September 1930.

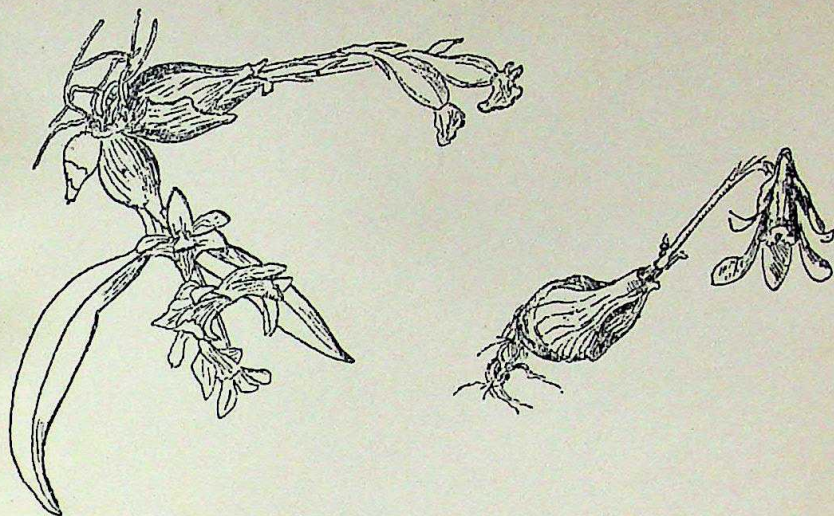
3. *Dendrobium ovatum* (Willd.) Kränzlin in Engl. Pflanzenr. iv, 50, ii, B 21 (1910) 71 ; Fischer Fl. Madras pt. viii (1928) 1416.—*D. chlorops* Lindl. in Bot. Reg. (1844) Misc. 44 ; Dalz. & Gibs. Bomb. Fl. 261 ; Veitch Man. Dendr. 27 ; Williams Orch. Grow. Man. 7th ed. 329 ; Sander Orch. Guide 68 ; Hook. f. F.B.I. v, 719 ; Cke. ii, 682.—*D. barbatulum* Wight Ic. iii (1843) t. 910.—*Cymbidium ovatum* Willd. Sp. Pl. iv, 1 (1805) 101.—Rheede Hort. Malab. xii. t. 7.

Description : Cke. ii, 682.—The flowers are very variable in size and colour. The midlobe of the lip is sometimes subacute or with a minute mucro in the same plant. The pubescent part in front of the ridge of the disk was green in Salsette specimens, the hairs at the very base of the lip on the sides of the ridge yellowish (Hallberg MS.).

Locality : Konkan : (Stocks) ; Thana forests, rainfall 150 in. (T. R. Bell 3624 !, 3647 !); Salsette (Hallberg !); Tulsi Lake, Salsette (McCann !); Wandra forests (Ryan 65 !); Sagwan (Ryan 359 !); Pen to Campoli, on trees (Gammie 16037 !); Khardi (Ryan 566 !); Wada range (Ryan 528 !); Bassein (Ryan 483 !, 896 !); Matheran (Birdwood) ; Thana District, on mango trees (Kirtikar).—*W. Ghats* : Khandala, rare (Blatter & Hallberg 26492 !); Mahableshwar (Cooke !); Phonda Ghat (Ritchie 1410).

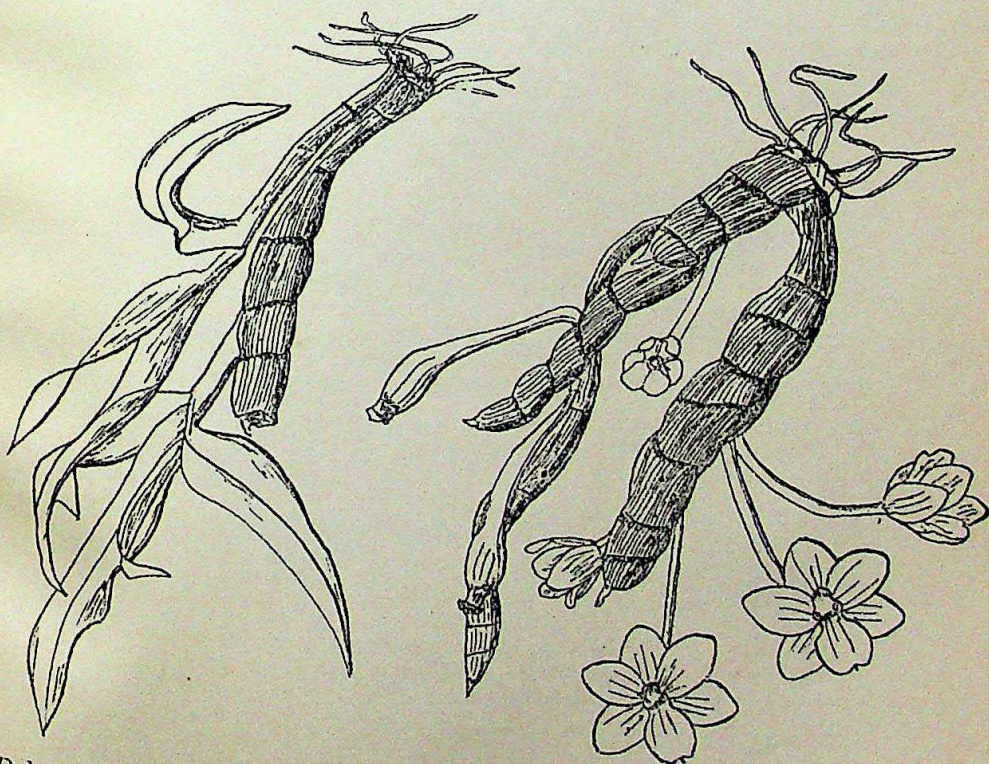
Distribution : W. Ghats and the W. coast of Madras Presidency from 150-5,000 ft.

4. *Dendrobium barbatulum* Lindl. in Wall. Cat. (1828) no. 2013, Gen. & Sp. Orch. (1830) 84 ; Paxt. Fl. Gard. iii, 113, fig. 285 ; Bot. Mag. t. 5918 (*non*



Del. C. McCann after Miss E. Bell.

Dendrobium microbulbon, A. Rich.



Del. C. McCann partly after Miss E. Bell.

Dendrobium crepidatum, Lindl.

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5444); Hook. f. F.B.I. v, 719; Veitch Man. Dendr. 21; Williams Orch. Grow. Man. 7th ed., 326; Cogn. Dict. Icon. Orch. Dendrob. t. 25; Cke. ii, 682; Fischer Fl. Madras pt. viii (1928) 1416; Kränzl. in Engl. Pflanzenr. iv, 50, ii, B 21 (1910) 70.

Description: Cke. ii, 682.—Notes: Cooke says that the midlobe is bearded at the base with yellow hairs. It would be more accurate to say that the midlobe is bearded in front of the channelled ridge and at the base of lip on the sides of the ridge (Hallberg MS.).

Locality: *Khandesh* (Hallberg!).—*Konkan*: (Stocks, Law); Thana forests, rainfall 150 in. (T. R. Bell 3637 bis!); Thana (Kirtikar); Kanari Caves (McCann!); Dapoli, Ratnagiri District (Kirtikar); Ratnagiri (Kirtikar).—*W. Ghats*: Khandala (Hallberg 26539!, Blatter 26540!, Blatter & Hallberg 26537!; McCann!); Kune, near Khandala (Blatter & McCann 26491!); Lonavla (McCann!); Sakarpatar (McCann!); Duke's Nose (McCann!); Tiger's Leap (McCann!); near Campoli (McCann!); Pen (McCann!); Kasara (McCann!); Igatpuri (McCann 26538!); Panchgani (Fernandez!); Bilar, 4 miles S.-W. of Panchgani (McCann!); on road from Panchgani to Mahableshwar (Blatter & Hallberg B 1682!); Mahableshwar, common (Cooke!, Ezekiel 26567!, 26569!).—*N. Kanara*: Tinai Ghat, 2,000 ft., rainfall 200 in. (Sedgwick 3616!).

Flowers from January to March. McCann has seen flowers of this species as late as the 29th May (1931) at Khandala.

Distribution: W. Ghats from Mysore to Travancore.

5. *Dendrobium herbaceum* Lindl. in Bot. Reg. (1840) Misc. 69; Hook. f. F.B.I. v, 719; Cke. ii, 682; Gammie in Journ. Bom. Nat. Hist. Soc. xvii, 32; Kränzl. in Engl. Pflanzenr. iv, 50, ii, B 21 (1910) 72; Fischer Fl. Madras pt. viii (1928) 1416.—*D. ramosissimum* Wight Ic. t. 1648; Dalz. & Gibs. Bomb. Fl. 261.

Description: Cke. ii, 682.

Locality: *Konkan* (Dalzell, Gibson).—*W. Ghats*: Mahableshwar (Woodrow!, Acland!); Koina Valley, below Mahableshwar (Cooke!); Wada, below Mahableshwar (Cooke!).—*N. Kanara*: Anmod, 2,000 ft., rainfall 200 in. (Sedgwick 3437!).

Distribution: W. Ghats of Madras Pres., from 2,000–4,000 ft., Godavari District, Parasnath, Bengal.

Flowers: October 1924 (Mahableshwar).

Fruit: December 1917 (N. Kanara).

6. *Dendrobium macrostachyum* Lindl. Gen. & Sp. Orchid. (1830) 78 et Bot. Reg. t. 1865; Wight Ic. t. 1647; Hook. f. F.B.I. v, 735; Cke. ii, 683; Kränzl. in Engl. Pflanzenr. iv, 50, ii, B 21 (1910) 59; Sander Orch. Guide 72; Fischer Fl. Madras pt. viii (1928) 1416.

Description: Cke. ii, 683.—Midlobe of lip embraces the whole column (Bell MS.).

Locality: *S. Konkan* (Dalzell 45!).—*W. Ghats*: Koina Valley, below Mahableshwar (Cooke!); Belgaum Ghats (Gammie).—*N. Kanara*: Forests (Herb. Econ. Bot. Poona); Yellapur, 2,000 ft., common (Sedgwick 2469!, T. R. Bell 6067!).

Distribution: W. coast and W. Ghats of Madras Pres. up to 7,000 ft., Travancore, Ceylon, Maldives, Central Provinces, frequent, Chota Nagpur, very doubtfully in Burma.

7. *Dendrobium crepidatum* Lindl. in Paxt. Fl. Gard. i (1850–51) 63; *nov. ed.* i (1882) 53, fig. 40; Bot. Mag. t. 4993 et t. 5011; Veitch Man. Dendr. 33; Hook. f. F.B.I. v, 740; Grant Orch. Burmah 78; King & Pantl. in Ann. Bot. Gard. Calc. viii, 48, t. 66; Dict. Icon. Orch. Dendrob. t. 40; Cke. ii, 683; Kränzl. in Engl. Pflanzenr. iv, 50, ii, B 21 (1910) 39.—*D. lawanum* Lindl. in Journ. Linn. Soc. iii (1859) 10; Dalz. & Gibs. Bomb. Fl. 261; Kränzl. l. c. 297.—*D. roseum* Dalz. in Hook Kew Journ. (1852) 291.

Kränzl. l. c. 39 considers *D. lawanum* Lindl. and *D. roseum* Dalz. as synonyms of *D. crepidatum* and has also included Law's specimen (Low by mistake) collected in the Konkan.

We don't quite see why the same author (l. c. 297) mentions *D. lawanum* as a distinct species under the heading '*Dendrobia adhuc solummodo in statu*

pelorioideo nota. He also adduces *D. roseum* Dalz. as a synonym and mentions the same specimen gathered by Law in the Konkan. Owing to an oversight, another mistake crept in in this place: The Konkan is put down as belonging to the botanical province of the tropical Himalaya.

Locality: Konkan (Law, Stocks); near Vengurla (Dalzell 33).—*IV. Ghats*: Mahableshwar Hills (Cooke !); Lonavla (Gammie 16241 !); Koina Valley below Mahableshwar (Cooke !); Belgaum Ghats (Gammie !).—*N. Kanara*: Anmod, 2,000 ft., rainfall 200 in. (Sedgwick 3319 !); Tinai Ghat (Gammie 15814 !).

Distribution: Chota Nagpur, Sikkim, Assam, Khasia Hills, Upper Burma (Kränzl mentions Malabar, but according to Fischer, Fl. Madras, this species has not been found in the area of his Flora).

8. *Dendrobium aqueum* Lindl. in Bot. Reg. (1843) Misc. 6, t. 54; Bot. Mag. t. 4640; Veitch Man. Dendr. 18; Sander Orch. Guide 67; Hook. f. F.B.I. v, 739; Kränzl. in Engl. Pflanzenr. iv, 50, ii, P 21 (1910) 52.—*D. album* Wight Ic. Pl. (1852) t. 1645; Williams Orch. Grow. Man. 7th ed. 324; Orch. Album t. 407.

Description: Stems fasciculate, decumbent, thickened from a thin base and slightly compressed, with many or several articulations, leafy, 30–45 cm. long, in the middle almost 1 cm. diam. Leaves ovate-lanceolate, acuminate; the sheaths widened above; lamina well-articulated, 8–12 cm. by 2–3 cm., striate, persistent during the flowering time. Racemes short, usually 2-flowered, rarely 3-flowered. Bracts very minute. Flowers white, suffused with green, lip suffused with pale yellow inside. Sepals and petals 3 cm. long, 1.5–1.8 cm. broad. Sepals ovate, lateral ones ovate-triangular, subfalcate; mentum very short, rotund. Petals obovate, equal in size, all acute. Lip 2.5 by 1.5 cm., subrhomboid, ascending from the base to the middle, then deflexed, acute in front, obscurely 3-lobed, rotund on both sides, in the middle of the disk slightly excavate, triangular in front, the whole disk puberulous, the margin of the midlobe denticulate-ciliate, a raised line from the base of the disk to almost the middle. Ovary with pedicel 2.5 cm. long.

Locality: Konkan (Stocks ex Kränzl.).—Sometimes grown in gardens of the Bombay Pres.

Distribution: W. Ghats of the Madras Pres. 3,000–7,000 ft.

9. *Dendrobium acilnomorphum* Blatter & Hallberg in Journ. Ind. Bot. ii (1921) 50, Fig. 4.

Description: A pendulous epiphyte with numerous very slender matted roots. Flowering stem reaching 25 cm., leafless, jointed, internodes thick, cylindrical, about 2 cm. long, slightly thickened below the nodes, fleshy, green, each internode completely enclosed in a scarious many-nerved sheath arising at the node and extending to about the middle of the next internode, tip of sheath 1 cm. broad, deeply emarginate, nerves parallel, 9 prominent ones alternating with 10 less conspicuous ones, prominent ones very stout and white. Last internode very short and conical. Leafy shoots appearing after the flowering at the base of the flowering stem. Leaves distichous; lamina of young leaves about 10 cm. long, with 5 conspicuous and many inconspicuous nerves; petiole amplexicaul, many-nerved. Flowers in pairs or solitary arising from the nodes. Pedicels stout, 2.5–3.5 cm. long, pinkish in flower, clavate and green in fruit. Flowers subregular, 3 cm. across, shallowly cup-shaped; sepals and petals subequal in length, pinkish, sepals 15 mm. long, about 7–8 mm. broad, oblong, subobtusely or mucronate. Petals and lip broadly ovate-oblong, 15–17 mm. long, 10 mm. broad, rounded or retuse at tip. Column very short, white, with 2 dark purple processes at the base, behind each of which there is a deep cavity (probably nectary). Anther terminal, flat on top, 2-celled. Pollinia 4, 2 in each cell, waxy, yellow, free in the cells, without caudicle or viscid appendage. Capsule about 2 cm. long, 1 cm. thick, pear-shaped, crowned by a cylindrical clavate process formed by the hardened column slightly trigonous.

Can be distinguished by the absence of the mentum. Otherwise agreeing in many points with *D. crepidatum* Lindl.

Locality: N. Kanara: Castle Rock (McCann 13768 !).

Distribution: Apparently endemic.

Flowers: March 1919.

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5. *DESMOTRICHUM* Blume (*emend. a Kränzlin*).

Epiphytic herbs. Stems long-pendulous, clothed with imbricating cataphylls, radical, branching. Branches often thickened into fusiform or subcylindrical bulbs which bear usually 1 leaf, rarely 2. Flowers fascicled, arising from the axil of the leaf, fugaceous. Bracts scarious, always much shorter than the thin pedicels, forming a capitulum. Dorsal sepal and smaller petals attached to the back and sides of the column; lateral sepals adnate to the foot of the column and forming with it a small mentum (spur) which is more or less closed in front. Basal part of lip always narrow, rather elongate, prolonged in front into small lateral lobes; midlobe flabellate or dilate, with the margin more or less pinnatifid or sinuate, always undulate or fimbriate or pilose, the 2 lines near the margin of the disk more or less undulate. Column as in *Dendrobium*. Species about 30.—Indo-Malayan.

The only species observed in the Presidency was usually known as *Dendrobium macraei* Lindl.

1. *Desmotrichum fimbriatum* Blume Bijdr. (1825) 329; Kränzlin in Engl. Pflanzenr. iv, 50, ii, B 21 (1910) 354; Fischer Fl. Madras pt. viii (1928) 1412.—*Dendrobium fimbriatum* Lindl. Gen. & Sp. Orchid. (183) 76. (*nec* Hook. *nec* Dalzell *nec* Wallich).—*D. Macraei* Lindl. l. c. 75; Dalz. & Gibbs. Bomb. Fl. 260; Hook. f. F.B.I. v, 714; Grant Orch. Burmah 104; King and Prantl. in Ann. Bot. Gard. Calc. viii, 61, t. 86; Cke. ii, 680; Gammie in Journ. Bomb. Nat. Hist. Soc. xvi (1905) 566.—*D. plicatilis* Lindl. Bot. Reg. (1840) Misc. 10.—*D. insulare* Steud. Nomencl. ed. 2, i (1841) 490.—*D. nodosum* Dalzell in Hook. Kew Journ. Bot. iv (1852) 292.—*D. flabellum* Reichb. f. in Bonpl. v (1857) 56 *et* Xen. Orch. ii, 75, t. 118, fig. 7.—*D. Binnendijkii* Reichb. f. Xen. Orch. ii (1865) 74, t. 118, fig. 6.—*D. Rabani* Lindl. in Journ. Linn. Soc. iii (1859) 7.—*D. pardalinum* Reichb. f. in Gard. Chron. ii (1885) 230.—*D. rhypidilobum* Schlecht. in Schum. & Lauterb. Nachtr. Fl. Deutsch. Schutzgeb. (1905) 151.—*D. Kunstleri* Hook. f. F.B.I. v, 714.

Description: Cke. ii, 680.

Locality: See Cke. l. c. 681.

Distribution: W. Ghats of Bombay and Madras Presidencies, Ceylon, Sikkim, Khasia Hills, Burma, Malay Peninsula and Archipelago to the Philippines.

6. *BULBOPHYLLUM* Thouars. (*Emend.*).

Hook. f. (in F.B.I. v, 772) says: 'The species of *Bulbophyllum* and *Cirrhopetalum* are in many cases so allied by cross affinities that the two genera might be regarded as one. My keeping them apart is due to the consideration of convenience, and the fact that all my attempts to commingle the species of both have resulted in a chaotic aggregate, with most unsatisfactory sectional characters.'

J. J. Smith in a paper entitled: *Bulbophyllum* Thou. sect. *Cirrhopetalum* [Bull. Jard. Bot. Buitenz. sér. 2, vii (October 1912) 19–29] has tried to neglect the view of Hooker's 'convenience' and to overcome his practical difficulties by transferring the species of *Cirrhopetalum* to the genus *Bulbophyllum*. We follow him.

The diagnosis of the genus *Bulbophyllum* must include those characteristics by which *Cirrhopetalum* was distinguished before by Lindley and Hook, f., viz. by the more often and regularly whorled flowers and by the short dorsal sepal, rarely half the length of the almost invariably much longer lateral, and finally by the very small stipitate lip.

Species about 550.—Tropical and subtropical.

- | | | |
|--|-----|------------------------------|
| 1. Sepals green. Flowers in umbels | ... | 1. <i>B. fimbriatum</i> . |
| 2. Sepals dull brownish yellow. Flowers in racemes | ... | 2. <i>B. neilgherrense</i> . |

1. *Bulbophyllum fimbriatum* Reichb. f. in Walp. Ann. vi, 260.—*Cirrhopetalum fimbriatum* Lindl. in Bot. Reg. (1839) Misc. 72; Bot. Mag. t. 4391; Wight Ic. 1655; Gammie in Journ. Bomb. Nat. Hist. Soc. xviii (1906) 34; Cke. ii, 686; Fischer Fl. Madras pt. viii (1928) 1420.—*C. Wallichii* Griseb. Cat. 205 (non Lindley).

Description : Cke. ii, 686 (under *Cirrhopetalum fimbriatum*).

Locality : Cke. l.c.—Add : W. Ghats : Mahableshwar (James in Herb. Calc. !, Hallberg !); Tinai Ghat (Bhide !).—N. Kanara : Very common at Astoli and towards Chandwadi, in flower and leafless at the end of March 1911 (Bell !).

Distribution : Bombay Pres.: Konkan, Deccan, S. M. Country, W. Ghats, N. Kanara; Coorg.

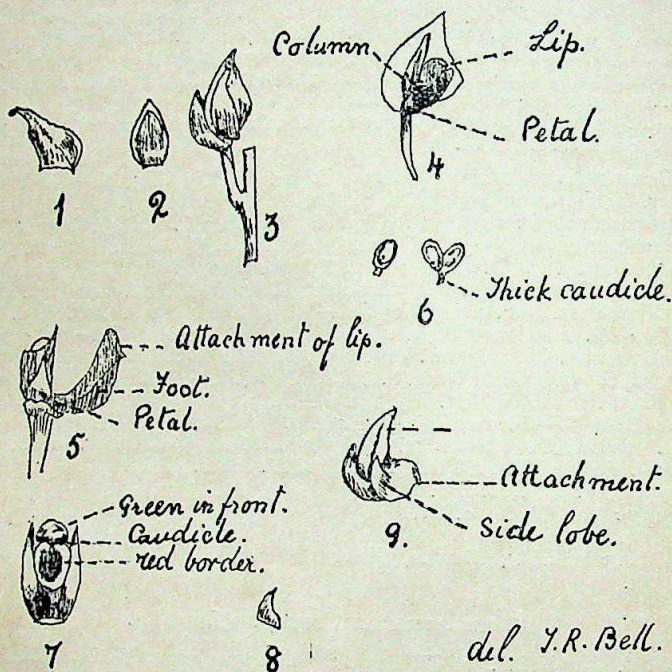


FIG. 1. *Bulbophyllum neilgherrense*, Wight.

- | | |
|------------------------|-------------------------|
| 1. Lateral sepal. | 6. Pollinia. |
| 2. Dorsal sepal. | 7. Column (front view). |
| 3. Bud. | 8. Petal. |
| 4. Column and lip. | 9. Lip. |
| 5. Column (side view). | |

2. *Bulbophyllum neilgherrense* Wight Ic. v (1852) 6, t. 1650; Bot. Mag. t. 5050; Gamie in Journ. Bomb. Nat. Hist. Soc. xvii (1906) 33; Cke ii, 686; Fischer Fl. Madras pt. viii (1928) 1418.

Description : Cke. ii, 686.—The pollinia are in pairs, one of each pair smaller than the other, applied closely along the inner faces, the outer faces convex; caudicle short, oblong, black. There are bulbs of all sizes bearing a single erect spike of flowers, densely packed, the larger bulbs bear larger spikes. Spikes catkin-shaped, flowering from below upwards. The flowers smell of highly rotten meat, and are chrome-yellow. Column white, the stigmatic hollow bordered thinly red, the foot also bordered red from stigma to end; lip with side lobes bordered blackish; cap yellow, greenish in front; pollinia pure bright yellow (Bell MS.).

Locality : W. Ghats : Belgaum Ghats (Gammie !).—N. Kanara : Ghats (Gammie !); Sampkhand (Woodrow); Yellapur, 2,000 ft., rainfall 100 in. (Sedgwick 2532 !); Kumbharwadi (Bell !).

Distribution : W. Ghats of Madras Pres.

7. TRIAS, Lindl.

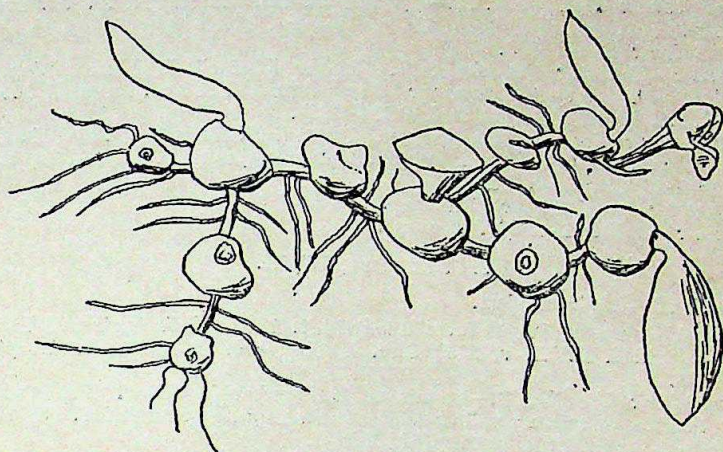


FIG. 2. *Trias Stocksii*, Hook. f.

Species 3.—Indo-Malayan.

1. *Trias stocksii* Hook. f. F.B.I. v (1890) 781; Gammie in *Journ. Bomb. Nat. His. Soc.* xvii (1906) 34; Cke. ii, 687.

Description: Cke. ii, 687.

Locality: Konkan (Law).—N. Kanara: (Stocks 69); Chandawadi (Bell!); Pavhol (Bell!).

8. PHOLIDOTA, Lindl.

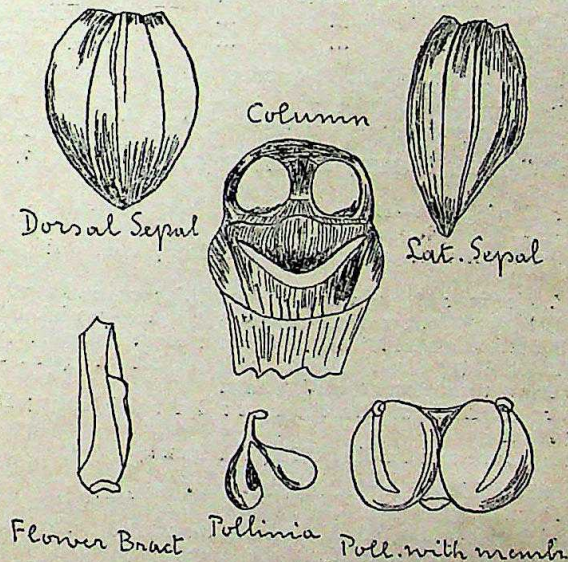


FIG. 3. *Pholidota imbricata*, Lindl.

Species 30.—Indo-Malayan, China.

1. *Pholidota imbricata* Lindl. in Hook. Fl. Exot. (1825) t. 138; Dalz. & Gibs. 262; Wight Ic. t. 907; Lindl. Bot. Reg. t. 1213 et t. 1777; King &

Pantl. in Ann. Roy. Bot. Gard. Calc. viii, 144, t. 201; Cke. ii, 688.—*Psilocnema imbricatum* Don Prodr. 33.—*Cymbidium imbricatum* Roxb. Fl. Ind. iii (1832) 460.

Description : Cke ii, 688.

Locality : *Konkan* : (Stocks); S. Konkan (Dalzell 51); near Vengurla (Dalzell & Gibson.).—*N. Kanara* : Sampkhand, 1,600 ft., rainfall 200 in. (Herb. S.X.C. 26516!, Sedgwick & Bell 6963!).

Distribution : Nepal, Chota Nagpur, Konkan, N. Kanara, W. and E. Ghats of Madras Pres., 2,000–3,500 ft., Ceylon, Malay Peninsula, China, Malay Archipelago to the Philippines, Pacific Islands.

Flowers : July 1895 (N. Kanara).

Fruit : October 1919 (N. Kanara).

9. JOSEPHIA, Wight.

Species 2.—India, Ceylon.

1. *Josephia lanceolata* Wight Ic. v (1852) 19, t. 1742 (*folia tantum*), *flores in* t. 1743; Hook. f. F.B.I. v, 823; Cke. ii, 688; Fischer in Fl. Madras pt. viii (1928) 1428.

Description : Cke. ii, 688.—Sepals white tinged with yellow. Petals and lip white. Anthers opercular, yellow with a brown spot on connective. Stigmatic lobes just in front of tip of anther (Hallberg).

Locality : *N. Kanara* (Stocks! in Herb. Calc.).—Has never been gathered in the Pres. since Stock's time.

Distribution : W. Ghats of Madras Pres., High Wavy Mountains.

10. PORPAX, Lindl.

Species 6 —Indo-Malayan.

Cooke mentions 2 species, we add a new one. Cooke's *P. lichenora* has to be changed into *P. jerdoniana* Reichb.

I. Flowers dark purple or dull red-brown.

1. Lip panduriform, crenulate ...

2. Lip ligulate ...

II. Flowers yellow ...

1. *P. reticulata*.

2. *P. papillosa*.

3. *P. jerdoniana*.

1. *Porpax reticulata* Lindl. in Bot. Reg. xxxi (1845) Misc. 62; Cke. ii, 689; Kränzl. in Engl. Pflanzenr. iv, 50, ii, B 21 (1911) 165.—*Eria reticulata* Benth. in Benth. and Hook. f. Gen. Pl. iii (1883) 509; Hook. f. F.B.I. v (1890) 786.—*Cryptochilus reticulatus* Reichb. f. in Bot. Ztg. (1862) 214.—*Aggerianthus marchantioides* Wight Ic. v (1852) 18, t. 1737 (Kränzl. habet *A. reticulatum* per errorem).

Description : Cke. ii, 689.—Bell & Sedgwick's specimen no. 6820 shows spathulate leaves.—Fruit globose, long-stalked, short-beaked, glabrous, about 6 mm. long, stalk almost as long, as the fruit, dorsal ridges of carpels prominent.

Locality : *N. Kanara* : Chandwar (Ritchie 1415); on rocks on the summit of Guddehalli Hill, 1,800 ft., rainfall 250 in. (Bell & Sedgwick 6820!); without locality, 1,800 ft., rainfall 100 in. (Bell 5979!); Khumbawada, 1,500 ft., rainfall 150 in. (Bell 6040!); Sirsi, 1,600 ft., rainfall 100 in. (Bell & Sedgwick 7002!).—Cooke says throughout the W. Ghats.

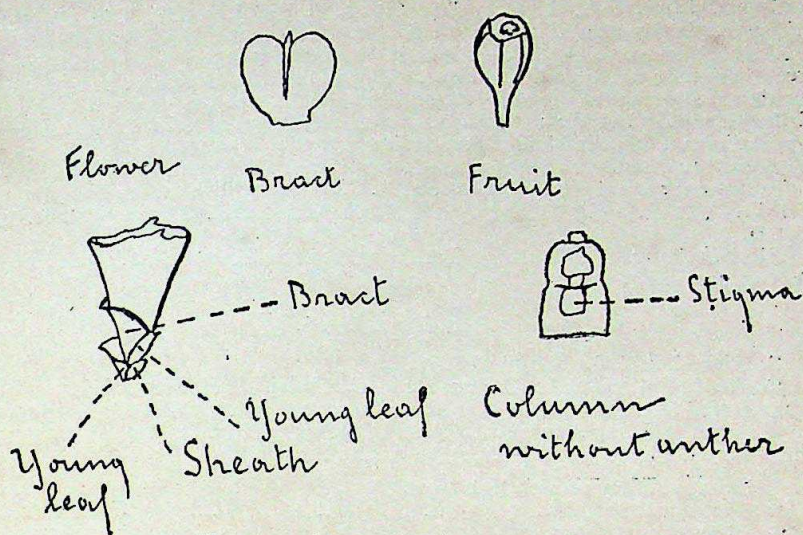
Distribution : *N. Kanara*, Madras Pres : Iyamalai Hills; Donipoya in S. Malabar at 700 ft.

Flowers : May, June and October 1919 (*N. Kanara*).

2. *Porpax papillosa* Blatter & McCann, *sp. nov.*

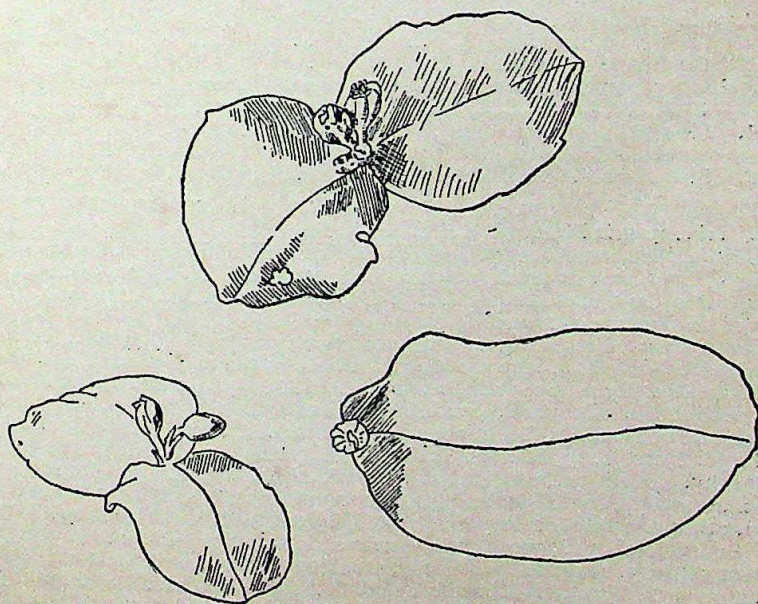
[*Accedit ad P. reticulatam* Lindl., sed distinguitur foliis et sepalis minutim papillois, bracteis minoribus, petalis falcatis 3-nerviis, labello ligulato, non panduriformi vel late ovato crenulato.]

Description : Pseudobulbs button-like, 1.8 cm. diam. Sheaths membranous, margin crisped, papillose. Leaves at time of flowering 2, shorter than bract, minutely papillose on both surfaces, conspicuously so on margin. Bract membranous, orbicular, retuse, apiculate. Flowers dull red-brown, brighter inside. Sepals united into a 3-lobed tube, densely minutely papillose with papillae in rows, 7-nerved, the outermost nerves from 2 adjoining sepals connivent downwards a little below the sinus. Petals 3-nerved, falcate-spathulate.

FIG. 4. *Porpax papillosa*, Blatter & McCann, sp. nov.

reaching the sinus in the calyx. Lip tongue-shaped, slightly papillose along margin, basal process prominent, elongate, narrowly triangular. Pollinia 8, anterior large, broad, pear-shaped, posterior smaller, narrow. Column with 2 ridges along the back, stronger at the top. Stigma forming a deep depression.

Locality: Prof. Hallberg found this species at Khandala in the W. Ghats in June 1917.

FIG. 5. *Porpax Jerdoniana*, Reichb.

3. *Porpax Jerdoniana* (Wight) Reichb. f. in Walp. Ann. vi (1861) 267; Kränzl. in Engl. Pflanzenr. iv, 50, B 21 (1911) 163.—*Eria lichenora* Lindl.,

in Journ. Linn. Soc. iii (1859) 46; Hook. f. F.B.I. v, 787; Cke. ii, 689.—*Lichenora jerdoniana* Wight Ic. v (1852) t. 1738.

Description: Cke. ii, 689.—Cooke is doubtful whether the dorsal sepal is free or connate with the lateral ones. Wight in his description says that the sepals are adherent at the base, though this fact is not shown in his drawing. Kränzlin says in his key: '*Sepalum dorsale liberum, cum lateralibus in unum biapiculatum connatis basi tantum coalitum.*'

Locality: *Konkan*: (Stocks, Law).—*W. Ghats*: Belgaum Ghats (Spooners!).—*N. Kanara*: Sampkhand (Herb. S. X. C. 26189!); Kadra, on trees, rainfall 200 in. (T. R. Bell 4285!); Anshi, 1,500 ft., rainfall 300 in. (T. R. Bell 6606!).

Distribution: W. Ghats of Bombay Pres. to Malabar and Travancore, Bababudan Hills.

11. ERIA Lindl.

Species about 330. Tropical Asia.

Cooke has 4 species: *E. reticosa*, *E. Dalzellii*, *E. microchilos* and *E. mysorensis*. We retain these, but *E. mysorensis* is being called *E. polystachya*. To these we add 2 species new to the Presidency: *E. exilis* and *E. pubescens*, and describe 2 new species: *E. rupestris* and *E. minima*.

A. Flowers solitary on slender scapes

- | | | | |
|--------------------------|-----|-----|--------------------------|
| I. Mentum bilobed ... | ... | ... | 1. <i>E. rupestris</i> . |
| II. Mentum not lobed ... | ... | ... | 2. <i>E. reticosa</i> . |

B. Flowers in racemes

- I. Small plants less than 10 cm. high. Leaves less than 7.5 cm. long. Scapes slender.

- | | | | |
|--|-----|-----|----------------------------|
| 1. Flowers secund. | | | |
| (a) Margin of sepals entire. Lip ovate-lanceolate ... | ... | ... | 3. <i>E. Dalzellii</i> . |
| (b) Margin of sepals ciliate with minute gland-tipped hairs. Lip panduriform ... | ... | ... | 4. <i>E. microchilos</i> . |
| 2. Flowers not secund. | | | |
| (a) Scape bracteate ... | ... | ... | 5. <i>E. minima</i> . |
| (b) Scape not bracteate ... | ... | ... | 6. <i>E. exilis</i> . |

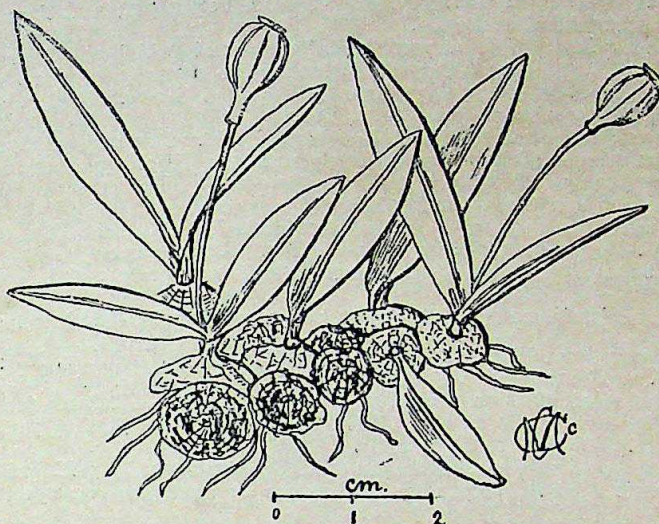
- II. Larger plants exceeding 10 cm. high. Leaves 10-20 cm. long. Scapes comparatively stout. ...

- | | | | |
|--|-----|-----|----------------------------|
| 1. Flowers 6-8 mm. long. Lip. entire, ovate-subpanduriform, subacute ... | ... | ... | 7. <i>E. polystachya</i> . |
| 2. Flowers 12-18 mm. long. Lip ovate-subcordate, acute ... | ... | ... | 8. <i>E. pubescens</i> . |

1. *Eria rupestris* Blatter & McCann, *sp. nov.*

[*Pertinet ad sectionem Conchidii. Persimilis Eriæ reticosæ Wight, distinguitur tamen bracteis mucronatis, mento bilobo, sepalo dorsali late oblongo non lanceolato, forma labelli lobo medio rotundato crenulato, fructu oblongo vel paulum obconico.*]

Description: Frequently found growing on perpendicular sides of rocks. Pseudobulbs disk-like, depressed, rounded or oblong, up to 2 cm. diam., covered with a fibrous net-work, one peduncle arising from the underside of the old pseudobulb. Leaves 2, contemporaneous with the flowers, when young ovate-acute or broadly oblong, mucronate, narrowed into a petiole 2 mm. long, the larger 3 cm. long, 12 mm. broad, dark green tinged with brown-purple, thin-fleshy, midrib depressed above, prominent below, margin densely beset with macroscopic crystalline hairs; smaller leaf up to 2.5 cm. long, up to 8 mm. broad, otherwise like the larger one; old leaves (at time of fruiting) 7 by 2.2 cm. Bud boat-shaped, green at the lower end, dirty purplish in the upper part. Flowers solitary, comparatively large, reaching 25 mm., arising from between the leaves with sheaths. Sheaths cylindric, up to 13 mm. long, lower part green, upper dingy purple, mouth oblique. Scape 1-flowered, purplish, curved by the weight of the flower, 1 mm. diam., up to 3.5 cm. long, thickened just below the flower. Bract immediately below the flower, membranous, almost orbicular, cordate, amplexicaul, pale brown-purple, mucronate at tip, with a dark midrib and 2 nerves. Sepals white or slightly suffused with pink;

FIG. 6. *Eria rupestris*, Blatter and McCann, sp. nov.

lateral ones elongate-triangular, falcate, mucronate, 2 cm. long, strongly 7-nerved above, obscurely so below, adnate to the long-produced foot of the column; dorsal sepal broadly oblong with the apex rounded or acute, more distinctly mucronate than the lateral ones, 2.2 cm. long. Mentum 4 mm. broad, bilobed. Petals broadly lanceolate, mucronate, obscurely 5-nerved, pure white, free, 18 mm. long, 6 mm. broad. Lip oblong-obovate, sessile on the foot of the column and incumbent, 19 mm. long, 9 mm. broad in the middle, white, 3-lobed; midlobe 8 mm. long, 4 mm. broad, oblong, rounded and crenulate at tip; lateral lobes short, narrow, resembling small ears, acute at apex, 2 pale yellow crests running from the base of the lip to a little beyond the lateral lobes, the tips of the lateral lobes and the area between them golden-yellow, the edge of the lip below the yellow area purple. Column short, at the top a small white hood, foot 10 mm. long, 3 mm. broad, edge purple, on the face many parallel purple lines which get fainter towards the end of the foot. Pollinia 8, obovoid, attached by fours to a short granular membrane. Fruiting scape up to 3.5 cm. long. Fruit oblong or slightly obconical, 6-lobed with 6 strong ridges, sometimes 3 alternate ridges weaker, up to 12 mm. long, 8 mm. diam. where broadest, truncate at apex.

This species is nearly allied to *E. reticosa* Wight, from which it can easily be distinguished by the bilobed mentum and by the shape of the lip.

As to the bilobed mentum, we take it for granted that Kränzlin's statement on this point is correct. He distinguishes, e.g. his *E. braccata* from *E. extindoria* by the large obtuse mentum, whilst *E. extindoria* has a long obtuse bipartite mentum. The fact that the new species has a bilobed mentum would be sufficient to mark it off as a species distinct from *E. reticosa*.

Regarding the shape of the lip, Wight describes the one of his *E. reticosa* as 'obscurely 3-lobed' and 'yellow'. Hooker f. (F.B.I. v, 787) says: 'lip nearly as long as the sepals linear-oblong 3-lobed, side-lobes rounded terminal ovate, disk with 2 crested ridges.' This description agrees fairly well with Wight's Ic. 1637, which by the way, does not quite explain Wight's description. Cooke, finally, gives this description: 'Lip $\frac{3}{4}$ in. long, 3 lobed; side-lobes long, narrow, rounded, white-edged with a purple line; midlobe $\frac{1}{2}$ in. long, ovate, acute, yellow at base and white towards the tip, the margins subcrenulate, disk with 2 crested ridges.'

The following points become clear from the above: The lip of *E. reticosa* is 3-lobed, the side lobes are long, narrow, rounded and the midlobe is ovate,

acute. In the new species the side lobes are very short, and the midlobe is oblong and rounded at the tip.

Locality: Panchgani, on perpendicular rocks of Tableland above Convent, also on rocks of Second Tableland, facing the monsoon-current, always in exposed situations (May Langham 231! type, Blatter 227!, 228!, 229! co-types); Lingmala, on tree (McCann!).

Flowered at the end of June 1925. Was also found flowering in other years about the middle of June, immediately after the breaking of the monsoon; also at beginning of July.

Fruit found on 1st September 1925.

In September new pseudobulbs were formed of the size of the old bulbs, surrounded at the base by 3 scarious sheaths. Sheaths broadly ovate, strongly nerved, suddenly contracted-acuminate; midrib very prominent below near the apex.

This species forms large dense patches, sometimes 0.5-1 m. across.

2. *Eria reticosa* Wight Ic. (1852) t. 1637; Hook. f. F.B.I. v, 787; Cke. ii, 690.—*E. uniflora* Dalz. in Hook. Kew Journ. Bot. iv (1852) 111.—*E. braccata* Dalz. & Gibbs. Bomb. Fl. 262 (non Lindl.).—*E. braccata* Kränzlin in Engl. Pflanzenr. iv, 50, ii, B 21 (1911) 18, fig. 1, A-B. (*partim*); Fischer Fl. Madras pt. viii (1928) 1425 (*partim*).

We cannot agree with Kränzlin and Fischer in uniting *E. reticosa* with *E. braccata* Lindl. We put the differences between the two species side by side.

	<i>E. reticosa</i>	<i>E. braccata</i>
Leaves	lanceolate or elliptic-lanceolate	oblanceolate
Pseudobulbs	netted	not netted
Sepals	acute	obtuse
Dorsal sepal	linear-lanceolate	oblong-lanceolate
Lateral sepal	falcate	nearly straight
Lip	3-lobed, at least obscurely	entire

In our opinion, these differences are sufficient to keep the two species separate.

Wight's plate 1637 of *E. reticosa* is, though not perfect, on the whole correct, and Wight's figure was drawn from the type specimen of *E. reticosa*.

We do not know what to make of Kränzlin's figure 1. Fig. 1 A is said to show the natural size. In the description the length of the sepals and petals is given as almost 3 cm. This size is reached not even in fig. 1 B which is said to be slightly enlarged. Then it is difficult to combine lip of fig. 1 B with its description "*labellum ligulatum vel oblongum, obtusum, lobi laterales obsoleti vel plica insiliente formati, vix conspicui*." Besides, the bract which is correctly drawn in Wight's Ic. as touching the flower is removed a good distance from it in Kränzlin's fig. 1 A and still more so and quite without proportion in fig. 1 B. In the latter the shape, too, has been changed entirely.

Now it is possible that Kränzlin wanted to draw a specimen approaching the type of *E. braccata*, but then we would say that the shape and position of the bract certainly forms another distinguishing character between *E. reticosa* and *E. braccata*.

Kränzlin's *Nota* at the end of his description does not improve matters. '*Reichenbachius*' he says, '*optimo jure Eriam reticosam cum E. braccata conjunxit, labellum enim quod ex Hookero in E. reticosa trilobum in E. braccata simplex describitur, re vera formam praebet quae neque stricto sensu simplex neque triloba judicanda est, subtrilobum s. pseudotrilobum*,' *margine*

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lateralis insiliente interrupto. We are afraid that the lip in his fig. 1 B is not even pseudo-trilobed.

Description : Cke. ii, 691.—The column is very short, more or less parallel-sided, straight. The anther terminal, surrounded along margin by a thin erect wall except where there is a membranous plate with upturned front-edge. Cap with 2 pockets, each holding 4 pear-shaped pollinia which are smooth and shiny (Bell MS.).

Locality : *Konkan :* (Woodrow!).—*W. Ghats :* (Dalzell! Herb. Calc.); Mahableshwar, on tree (Sedgwick 7916!); Lingmala, on rocks, 4,000 ft. (Sedgwick 7899!); Lonavla, very common (Gammie!); Castle Rock, 1,800 ft., rainfall 300 in. (T. R. Bell 4336!); Ramghat (Ritchie 707).

Distribution : W. Ghats from the Bababudan to the Nilgiri Hills at about 6,000 ft., High Wavy Mountains.

Flowers : June 1921 (Lingmala).

Fruit : August 1921 (Mahableshwar); September 1918 (Castle Rock); November 1918 (Mahableshwar).

3. *Eria Dalzellii* Lindl. in Journ. Linn. Soc. iii (1858) 47; Dalz. & Gibs. Bomb. Fl. 262; Gammie in Journ. Bomb. Nat. His. Soc. xvii (1906) 36; Cke. ii, 691; Kränzl. in Engler's Pflanzenr. iv, 50, ii, B 21 (1911) 19, fig. A-C (*partim*).—*E. filiformis* Reichb. f. in Wulp. Ann. vi, 268 (*partim*).—*Dendrobium filiforme* Wight Ic. v (1852) t. 1642 (central and top left-hand figs.).

Description : Cke. ii, 691.

Locality : *Konkan* (Stocks).—*W. Ghats :* Khandala (Hallberg 26520!, Blatter & McCann 25839!, McCann 25834!, Blatter 25840!); Lonavla (Chibber!); Panchgani (Herb. Econ. Bot. Poona!); Lingmala (McCann!).—*N. Kanara :* Yellapur, 1,500 ft. rainfall 100 in. (T. R. Bell 3909!); near Karwar, on tree, sea-level, rainfall 120 in. (T. R. Bell 7873!); Jog, on tree, 1,400 ft., rainfall 200 in. (Sedgwick 7171!); without locality (T. R. Bell 4265!).

Distribution : W. Ghats of Bombay and Madras Pres.

Flowers : July 1916 (Khandala); August 1918 and 1920 (N. Kanara); October 1919 (N. Kanara) September 1931; (Lingmala).

4. *Eria microchilos* Lindl. in Journ. Linn. Soc. iii (1858) 47; Gammie in Journ. Bomb. Nat. His. Soc. xvii (1906) 36; Cke. ii, 691.—*E. Dalzellii* var. *fimbriata* Hook. f. F.B.I. v, 789.—*Dendrobium fimbriatum* Dalz. in Kew Journ. Bot. iv (1852) 292.—*D. microchilos* Dalz. in Kew Journ. Bot. iii (1851) 345.—*Eria Dalzellii* Kränzl. in Engler's Pflanzenr. iv, 50, ii, B 21 (1911) 19 (*partim*).

This species was united by Hook. f. with *E. Dalzellii* Lindl. and Kränzl. l.c. has followed him. Gammie and Cooke keep the two species distinct. We agree with them. Gammie has pointed out the following differences:

	<i>E. Dalzellii</i>	<i>E. microchilos</i>
Venation of pseudo-bulbs.	principal venation pinnate	principal venation flabellate.
Lip	ovate-lanceolate with 2 thickened ridges near base.	fiddle-shaped, the almost obsolete ridges extending to the middle of the lip, where they join to form a single line towards the apex.
Colouration of lip	green suffused with yellow on the basal half and white on the upper.	yellow on lower half and white on the upper.
Column	green	nearly white.

Description : Cke. ii, 691.

Locality : *Konkan* (Stocks, Gammie !); Wari country, on mango trees (Dalzell & Gibson).—*W. Ghats*: Khandala, on a boulder in a mountain stream, 2,500 ft., rainfall 250 in. (Hallberg !, Sedgwick 2645 !); Mahableshwar (Cooke!).

Flowers : July 1917 (Khandala).

5. *Eria minima* Blatter & McCann, *sp. nov.*

[*Pertinet ad sectionem Conchidii. Accedit ad Eriam exilem* Hook. f. *a qua tamen distinguitur scapo bracteato, bracteis late ovatis (non lanceolatis), floribus minoribus, sepalis aquilongis, pede gynostemii longo et labello relative longiore.*]

Description : A very small epiphyte, 1-3 cm. high. Pseudobulbs flat, irregularly orbicular or obovoid or broadly obovoid or rhomboid, adhering end to end like a chain, up to 12 mm. diam., grey or light olive-green when dry, with a membranous coat more or less reticulately veined, with a thickened margin. Leaves usually appearing after the flowers or with them, usually 2, sometimes 3, very variable in size and shape, obovate or oblong-obovate and tapering at base, or oblanceolate, or oblong, always rounded and apiculate at apex, always distinctly 7- or 9-nerved when dry, sheathing, very thin, light brown or olive when dry. Scape 1-3 cm. long, capillary, zig-zag, arising from between the leaves with a few minute sheaths at the base, bracteate at every bend of the axis (not nude as in *E. exilis*). Bracts broadly ovate-cordate, acute or apiculate or acuminate, hyaline, semi-amplexicaul, as long as the stalked ovary, 1-1.5 mm. long. Flowers minute, up to 6 in a raceme up to 10 mm. long, 1 at every bend of the axis, about 1.5 mm. long; distance between 2 flowers 1-2 mm. Sepals obtuse or subacute, all of the same length; dorsal oblong; lateral ones very broad at base, forming a stout saccate mentum almost as long as the upturned tips of the sepals. Petals small, oblong, half the length of the sepals. Lip oblong-ligulate, sessile on the foot of the column and incumbent, curved, longer than the petals, but shorter than the sepals. Column with an elongate foot. Anther ovate.

Locality : *N. Kanara* : Anmod, on trees 2,000 ft., rainfall 200 in. (Sedgwick 3260 ! type, T. R. Bell 4443 !); Siddhapur, 1,400 ft., rainfall 100 in. (Sedgwick 7269 !); Jog, on tree, 1,400 ft., rainfall 200 in. (Sedgwick 7170 !).—*W. Ghats* : Mahableshwar (Blatter & Hallberg B 1683 !, Sedgwick 7631 !, Ezekiel 26570 !, McCann !).

Flowers : October 1919 (Siddhapur, Jog); October 1920 (Mahableshwar); December 1907 (Anmod); February 1917 (Mahableshwar).

6. *Eria exilis* Hook. f. F.B.I. v. (1890) *et* Ic. Pl. xxi, t. 2074; Kränzl. in Engler's Pflanzenr. iv, 50, ii, B 21 (1911) 21; Fischer's Fl. Madras pt. viii (1928) 1425.—*E. microphyton* Schlechter in Fedde Repert. ii (1906) 170.

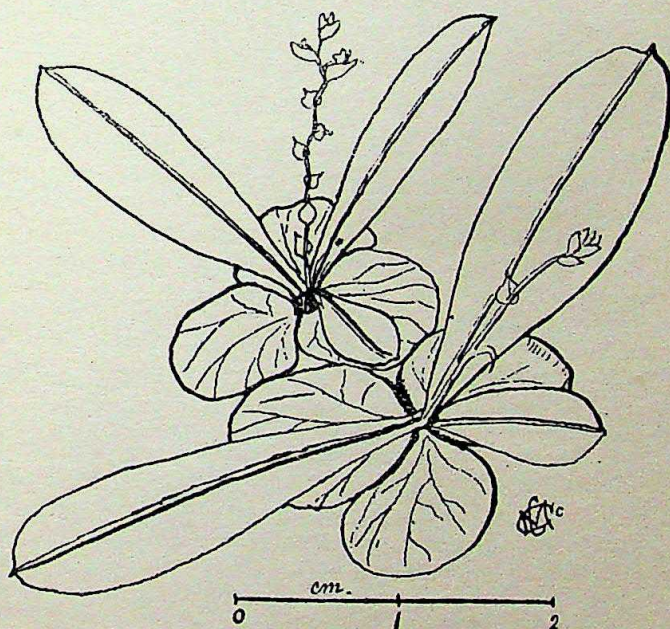
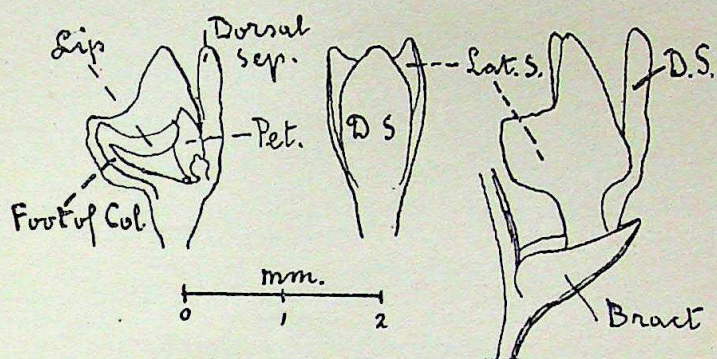
Description : A delicate plant, up to 10 cm. high. Pseudobulbs well approximate, ellipsoid, 1-1.3 cm. diam., leafless at time of flowering. Leaves unknown. Scape arising near the apex of the pseudobulbs, slender, with some hyaline little sheaths, naked, 4.5-6 cm. high. Spike few-flowered (6-15). Bracts ovate-lanceolate, acuminate, hyaline, shorter than the flowers. Flowers white. Sepals oblong, acute, scarcely 3 mm. long, connate for the lower $\frac{1}{2}$, lateral ones oblique. Petals obliquely lanceolate-elliptic, narrowed towards the base, slightly shorter than the sepals. Lip oblong-ligulate, obtuse, glabrous, arcuate, slightly shorter than the petals. Column short; foot almost absent; clinandrium entire; rostellum wide, ascending, triangular, obtuse; another broadly ovate, obtusely apiculate in front, glabrous; pollinia 8, pyriform, oblique; ovary short-pedicelled, glabrous, 2 mm. long.

Locality : Mahableshwar (Cooke ! in Herb. Calc.).

Distribution : Travancore, Ceylon, Siam.

7. *Eria polystachya* A. Rich. in Ann. Sc. Nat. 2 sér. xv (1841) 20, t. 9; Hook. f. F.B.I. v, 792; Kränzl. in Engl. Pflanzenr. iv, 50, ii, B 21 (1911) 64; Fischer Fl. Madras pt. viii (1928) 1425.—*E. pubescens* Wight Ic. t. 1635.—*E. mysorensis* Lindl. in Journ. Linn. Soc. iii (1858) 54; Hook. f. F.B.I. v, 793; Gammie in Journ. Bomb. Nat. Hist. Soc. xvii (1906) 37; Cke. ii 692.

Description : Cke. ii, 692.



Eria minima, Blatter & McCann, sp. nov.

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Locality: *Konkan*: (Stocks).—*W. Ghats*: (Gammie!); Mahableshwar (Gammie!, James!, Herb. Calc. Woodrow!); Koina Valley below Mahableshwar (Cooke!, Herb. S.X.C. 26521!).—*S.M. Country*: Dharwar (Law).

Distribution: W. slopes of the Nilgiris, Bababudan Hills, Malabar, Travancore, Maldives, Ceylon.

8. *Erla pubescens* Wight Ic. (1856) 1634, in tab. *E. polystachya dicta*; Hook. f. F.B.I. v, 793; Kränzl. in Engler's Pflanzenr, iv, 50, ii, B 21 (1911) 64.

Description: Pseudobulbs short, ellipsoid, as thick as the thumb. Leaves pubescent, soon deciduous, up to 15 cm. long, 2 cm. broad, lanceolate. Racemes arising from amongst the leaves, slightly drooping, longer than the leaves, sparingly puberulous. Flowers 1.2–1.6 cm. long, 2 cm. diam., white, tipped with pink. Sepals lanceolate, acute, 5-7-nerved, white with pale streaks, dorsal one longest, mentum almost none. Petals linear-lanceolate, acute, 5-nerved. Lip entire, much broader than the sepals, ovate-cordate, acute, slightly sinuate on both sides, with purple blotches and yellow tip, 2 low short ridges in the lower third of the base of the disk; column short, no stelidia.

This species is very nearly related to *E. polystachya* A. Rich., but can be readily distinguished by its pubescent leaves, its much larger leaves and 5-7-nerved, white and pale streaked sepals.

Locality: *W. Ghats*: Mahableshwar (Hallberg!).

Distribution: W. slopes of the Nilgiris.

(To be continued)

THE LONG-TAILED MACAQUE MONKEYS (*MACACA
RADIATA* AND *M. SINICA*) OF SOUTHERN INDIA
AND CEYLON.

BY

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Examination of the Bonnet Monkeys collected in the Eastern Ghats and a comparison of them with the splendid series of skins and skulls previously collected by the Mammal Survey in various parts of South India yielded so many interesting results, never before recorded, that I was induced to take up the study of the Ceylon species as well. My observations and conclusions are set forth in the following pages.

THE BONNET MACAQUE (*Macaca radiata*).

The Colour-variations of the Bonnet Macaque.

In view of the evidence I have discovered for the existence of more than one race of this monkey in India, it must be recalled that Geoffroy's description of his example as 'brun-verdatre' fixes the colour of the typical sub-species or local race. I consequently assign to this race (*M. radiata radiata*) a number of specimens, obtained in several districts by the Survey, which exhibit various shades of olive-brown.

A hasty inspection of the skins suggests at first the occurrence of local races of this type; but the available evidence points to the conclusion that the marked differences in tint are due to seasonal change. Unfortunately it was not possible to collect throughout the year a series of examples attesting month by month the changes in colour and coat in one locality. When this is done for various districts, it may prove that more than one race is represented by the olive-brown type. But at present there is not sufficient material to justify, in my opinion, that conclusion.

The general tint of the winter coat on the dorsal area is deep brown or olive-brown with little, if any, pale ticking or speckling in the hair. The long radiating hairs on the bonnet and the short hairs diverging from the middle line of the forehead in front are greyish brown at the base, blackish distally. The outer sides of the arms are rather paler than the back, there being more grey in the hair; and the legs and feet are greyer than the arms. The tail is black above in its basal half, turning to deep brown distally.

The under side and inner side of the limbs are clothed with whitish grey hairs which show up conspicuously on the black pigmented skin of the chest and abdomen.

In the spring and early summer the long hairs of the upper side fade through the greater part of their length to a pale buffish tint giving a decidedly pale olive-grey or buffy grey colour to the skins. The hair then looks dull, lustre-less and shaggy and is decidedly coarser to the touch than the rich brown coat of mid-winter.

The following skins may be referred to in illustration of this summary of the seasonal colour-changes.

An adult male and female shot on December 20 by Shortridge on the Haleri Estate, N. Coorg, 3,555 ft., have the coat long and soft, deep brown in colour with scarcely a trace of pale speckling in it. Two obtained by J. A. Graham at the same place on January 16, have the coat somewhat coarser and paler.

An adult male from Ghatmatha, Satara (S. H. Prater), dated December 17, is also a deep olive-brown with inconspicuous ticking on the nape and shoulders.

A male and three females from Dharwar, 2,300 ft., (G. C. Shortridge), November 14, are very like the Satara specimen but a little paler.

Six specimens, an adult male and five females, from Samasgi the Kanara Boundary, S. W. Dharwar, 2,000 ft., (G. C. Shortridge), on March 12th, have the coat on the average longer, shaggier and much paler owing to an extensive pale buffish-olive area on the hairs.

A female from Karumbapatti, Salem, April 21st, and a male and two females from Malakondapenta in the Kurnool District, May 14th (N. A. Baptista), have the coat long and shaggy, consisting of dead hair extensively olive grey in colour. At a little distance these skins appear to represent a sub-species easily distinguishable from the one represented by the deep brown skins from Satara and the Haleri Estate in North Coorg; but the differences between them and the series from Samasgi in S. W. Dharwar are comparatively slight.

The examples in the British Museum I assign to this race were collected in the following districts:—

Satara (S. H. Prater). Dharwar 2,300', Kanara 2,000', (G. C. Shortridge), Kurnool (N. A. Baptista), Mysore, Devikop in S. Mahrata, N. Coorg 3,555', S. Coorg 2,000' (G. C. Shortridge), Shevaroy Hills 4,500' (N. A. Baptista), Nilgiri Hills 5,120' (P. Gosse), Kodaikanal 5,500' (C. McCann), Cochin 1,500' (R. O'Brien), Palni Hills 3,000'–4000' (R. O'Brien and C. McCann).

There are, however, a few specimens from other localities which deviate from them in certain particulars regarding colour. For example, a full-grown male from Vijayanagar in Bellary 1500', obtained by Shortridge on August 12th, can be picked out at once by the distinct yellowish speckling giving a greener aspect to the pelage, the bonnet and forehead and the base of the tail are not so dark and the legs below the knees are greyer. But a young male from the same place, shot on August 4, is like the series from Dharwar.

Very similar greenish yellow speckling may be seen in two examples obtained by J. Riley O'Brien on May 28th at Shernelly in Cochin 1,500'. Superficially these examples are tolerably uniformly olive-brown in colour, the coat being dull and in process of moulting. But the speckling is revealed in the newly erupting hair when the old coat is parted.

These markedly yellow-speckled specimens coming from widely separated districts may for the present be set aside as varieties.

A pale example of a different type, an immature female from Cumbum in Madura obtained by S. H. Prater on May 17th also looks suggestively different with its annulated hairs from the typical form. But that too must be set aside.

Another specimen, a sub-adult female collected by G. C. Shortridge on May 27th at sea-level below the Gersoppa Falls in Kanara, differs from the typical form in exhibiting a decidedly reddish-brown tinge especially on the flanks, shoulders and sides of the neck, and to a lesser degree on the limbs and tail. As may be inferred from the date the pelage is lustre-less and no doubt faded. Probably the reddish tint would have been brighter five or six months earlier. A young one, collected with her, is, however, normally tinted. She measured in the flesh: head and body 1 ft. 6½ ins., tail 1 ft. 9½ ins.; total 3 ft. 4 ins., and her weight was 9 lbs.

Provisionally at all events I treat this example as an erythrismic sport. It is, however, the only representative of this monkey taken at sea-level that I have seen; and the interest of the coloration lies in its approximation to that of the Ceylonese Toque. Possibly the record of the Toque from India by Gray was due to his knowledge of similar reddish specimens of the Bonnet. The skin is quite as red on the back as some specimens of the Toque, but it does not show the redness of the thighs observable in the brownest examples of the Ceylonese species.

Two specimens appear to represent a distinguishable local race, which may be described as follows:—

Subsp. *M. radiata diluta* nov.

Differs from typical *M. radiata* in being much paler in tint throughout. The hairs of the forehead are buff with darker tips, those of the 'cap' are a pale brownish buff without dark tips but grey at the base. The hairs of the neck and shoulders are long and, like those of the rest of the back, have long buff tips. The arms, legs and tail are correspondingly paler and buffier. The hairs of the belly and of the insides of the limbs instead of being whitish grey are creamy white, and the skin of the chest and abdomen is pallid, not dark blackish grey.

Locality: Boothapaundy in Travancore.

Two female examples, one nearly adult, the other younger, obtained by R. S. Pillay on November 18. The skins are in good coat and differ noticeably in their paler coloration from examples of typical *radiata* shot by Shortridge on November 14 at 2300' in Dharwar. They more nearly resemble the pallid, faded skins obtained on March 12 at Samasgi in S. W. Dharwar and those from

Salem and Kurnool obtained on April 21 and May 14 respectively, but are not the same tint above and are noticeably different from them and from all the skins of typical *radiata* obtained at various months of the year by the absence of dark pigment in the integument and by the creamy tint of the hairs of the under side.

The dimensions of the two skins, the adult measuring: head and body 1' 4 $\frac{1}{2}$ ", tail 1' 10 $\frac{1}{2}$ ", total 3' 3 $\frac{3}{8}$ ", and the younger: head and body 1' 1 $\frac{1}{2}$ ", tail 1' 9", total 2' 10 $\frac{3}{8}$ ", show that this monkey is as large as typical *radiata*, a conclusion borne out by the measurements of the skull of the type entered on the subjoined table.

The measurements and weights, taken in the flesh, of some of the examples of *M. radiata*, collected by the Mammal Survey, are as follows:—

Locality and Sex		Head & Body	Tail	Total	Weight	Remarks
Vijayanagar, Bellary,	♂ ad.	1' 11 $\frac{1}{2}$ "	2' 3"	4' 2 $\frac{1}{2}$ "	19 $\frac{1}{2}$ lbs.	Typical <i>radiata</i> .
Dharwar,	♂ ad.	1' 10 $\frac{1}{2}$ "	2' 0 $\frac{3}{8}$ "	3' 11 $\frac{1}{8}$ "	...	"
Haleri Estate, N. Coorg,	♂ ad.	1' 9 $\frac{1}{2}$ "	1' 8"	3' 5 $\frac{5}{8}$ "	13 lbs.	"
Samasgi, Kanara,	♂ ad.	1' 9 $\frac{1}{2}$ "	1' 10 $\frac{3}{8}$ "	3' 7 $\frac{1}{8}$ "	14 $\frac{1}{2}$ lbs.	"
Ghatmatha, Satara,	♂ ad.	1' 8 $\frac{1}{2}$ "	2' 1 $\frac{3}{8}$ "	3' 9 $\frac{1}{8}$ "	16 lbs.	"
Dharwar,	♀ ad.	1' 8 $\frac{3}{8}$ "	1' 10 $\frac{3}{8}$ "	3' 7 $\frac{1}{8}$ "	...	"
Samasgi, Kanara,	♀ ad.	1' 7 $\frac{1}{2}$ "	1' 8 $\frac{1}{2}$ "	3' 4"	8 $\frac{1}{2}$ lbs.	"
Haleri Estate, N. Coorg,	♀ ad.	1' 6 $\frac{1}{2}$ "	1' 5 $\frac{1}{2}$ "	2' 11 $\frac{3}{8}$ "	8 $\frac{1}{2}$ lbs.	"
Wottekolle, S. Coorg,	♀ ad.	1' 6"	1' 8 $\frac{1}{2}$ "	3' 2 $\frac{1}{2}$ "	...	"
Boothapaundy, Travancore,	♀ ad.	1' 1 $\frac{1}{2}$ "	1' 9"	2' 10 $\frac{1}{2}$ "	...	Type of <i>diluta</i> .

With regard to general superiority in size of the males over the females, this table confirms the table giving weights and measures of the specimens collected in the Eastern Ghats. The two sexes do not always differ greatly in actual length, but males are always considerably heavier. The specimens enlisted above are the largest procured. Special attention may be drawn to the very big male shot by G. C. Shortridge in Bellary and to the big female, as long as many males, obtained by him in Dharwar. The female from Samasgi is the largest of a series of six, the weights of the others being 8 lbs. The tail, it may be seen, is as a rule longer than the head and body. Where it is shorter, the great possibility of artificial abbreviation must be borne in mind.

The Skull of M. radiata.

Blanford described the skull of this monkey as 'long, flattened over the brows with the orbits much broader than high and vertical,' and he gave the total length and zygomatic width of the skull of an

adult male as 4.8 inches (=120 mm.) and 3.5 inches (=87½ mm.) respectively. Since all the skulls of adult males I have measured are much narrower across the cheek-bones and have the orbital sockets approximately circular and sometimes higher than wide, I have no doubt that he selected for measurement one of the several skulls, in the British Museum, of examples of this monkey that had been reared in captivity, probably in the Zoological Gardens. These may be distinguished at once by their low brows, imparting a peculiarly scowling aspect to the skull, as well as by other characters from the skulls of wild-killed specimens. Blanford's record is therefore valueless.

The following table gives some dimensions in millimeters of male and female skulls of the two races recorded above. The table shows the difference in cranial size between the males and females of *M. radiata* and also some of the individual differences between members of the same sex:—

Locality and Sex		Total length	Zygomatic Width	Orbital Width	Upper Molars	Lower Jaw	Remarks
Coorg	♂ ad.	121	78	61	32	87	Typical race.
"	♂ ad.	119	77	57	31	86	"
Nilgiri Hills	♂ ad.	117	80	65	30	84	"
Kotagiri, Nilgiris	♂ ad.	116	77	59	31	80	"
Coimbatore	♀ ad.	105	67	56	29	72	"
Coorg	♀ old.	105	72	58	29	73	"
"	♀ old.	103	68	54	30	71	"
Kotagiri, Nilgiris	♀ old.	104	69	55	30	...	"
Dharwar	♀ ad.	102	69	55	30	73	"
"	♀ ad.	99	63	51	28	69	"
Kanara (sea-level)	♀ young	100	...	53	...	...	Reddish variety.
Travancore	♀ ad.	105	72	56	28	...	Type of <i>diluta</i> .

Apart from size, the two adult male skulls from Coorg differ in the shape of the palate and of the orbits. In the larger example, the rows of cheek-teeth are approximately straight and parallel, and the orbital sockets are nearly circular, measuring 20 by 20 mm. In the smaller the rows of cheek-teeth are noticeably arcuate and the orbital sockets are higher than wide, measuring 22 by 20 mm. Female skulls may, of course, be at once distinguished from male skulls by their small canine teeth, accompanied by a narrower and

shorter muzzle. In shape they resemble the skulls of sub-adult males; but the cheek-teeth are only slightly shorter than those of males, and the orbital sockets are quite as large.

THE TOQUE MACAQUE (*Macaca sinica*).

Examination of the specimens of the Bonnet Macaque suggested a revision of the specimens in the British Museum, mostly obtained by the Mammal Survey, of its Ceylonese ally the Toque Macaque (*M. sinica*). The skins proved a puzzling series and perhaps the following remarks about them may prove of interest:—

Differences between the Bonnet and the Toque Macaques.

The degree of kinship between these two monkeys has always been open to doubt. Most authors have treated them as distinct on account of the prevalent difference between them in colour and the alleged difference in size, the Ceylon form being redder and smaller than the Indian. Such characters, however, have only a sub-specific value in the case of the Crab-eating Macaque of Malaya and the Sunda Islands; and Blanford, after describing the Bonnet and the Toque, said 'it is very doubtful if there is any constant difference, [between them]. For my own part, I doubt if the two are entitled to specific distinction.' Hinton and Wroughton, however, claimed that, apart from its red colour, the Toque may be distinguished by the forward growth of the hairs up to the eyebrows on the forehead, the corresponding hairs in the Bonnet diverging sideways from a median parting.

Comparison of the skins in the British Museum shows that none of these three characters is absolutely distinctive and constant. But there is one difference, hitherto unnoticed, which appears to admit of no exception. In the Bonnet Macaque, the hair on the cheek in front of the ear grows upwards from the throat and lower jaw to the level, or nearly so, of a line running from the eye to the summit of the ear where the tips meet those of the hairs of the crown which diverge transversely from the middle line. In the Toque Macaque, the hairs on the cheek in front of the ear slope obliquely downwards and backwards and meeting the upwardly growing hair from the throat and lower jaw form a distinct whorl on the cheek and often a definite crest below the ear. This whorl varies in size and distinctness, possibly due in part to the 'make-up' and shrinkage of the skins; but it is always detectable.

Variations in the Toque Macaque.

The available skins of this monkey are not sufficient to supply a full explanation of the variations in general colour and in the growth of the hair on the forehead.

A series of five collected by Major E. W. Mayor between September 24th and October 4th at Mankeni on the coast of the Eastern Province, may be selected as a basis for comparison.

Two adult males, weighing 12 lbs. and 10 lbs. respectively, have the fore part of the back reddish brown; this tint increases in brightness on the hind back and loins and is especially bright, almost orange, on the outside of the thighs and shoulders but becomes duller and dies away distally on the limbs, the arms being brighter than the legs. The tail is greyish brown to blackish above, speckled with orange at the base. On the head the 'cap' consists of long radiating hairs, greyish below and yellowish buff at the tip, which overlie and mostly conceal laterally and in front a fringe of shorter hairs rendered conspicuous by a bright orange band preceding the black tip. The hairs of this fringe, which narrows in front, grow forwards up to the eye-brows. The cap is set off by greyish hairs on the cheek and over the ear. The under side of the body and tail and the inner sides of the limbs are clothed with whitish grey hairs.

A half-grown male, weighing 6 lbs., resembles the adults in colour; but the fringe does not cover the forehead, a short area behind the eye-brow being covered with hairs growing backwards and outwards.

A female, unmeasured and undated, has the brow as in the young male; but the pelage is less brightly coloured than in the males.

A very young male, weighing only 2 lbs., is well coloured, but has the long hairs of the cap much shorter and not overlapping the forehead which is covered to the brow with short hairs directed forwards and outwards, there being no definite orange-edged fringe.

Compared with this series an adult female from Tellula 300, in Ura, shot in April, and an adult female from Wellawaya in Ura, shot in July, are as richly coloured as the adult males from Mankeni and have the forehead similarly covered to the brow by the orange-edged fringe. The coat in the female from Wellawaya is, however, a little longer. A young one killed with her is also very like the young one from Mankeni.

In north western Ceylon Major Mayor also secured some interesting specimens. An adult male shot at Cheddikulam on November, 11th has the forehead covered to the brows as in the adult males from Mankeni; but the margin of the fringe is dull buffy yellow, not bright, and the general colour of the head, shoulders, back and arms is yellowish olive without a trace of red. The only red present in the pelage is on the outer side of the thigh, which is orange but not so bright as in Mankeni specimens.

A younger male, three-quarters grown, from the same place and shot on November 26th, is dark brown in hue, also without any bright yellow or orange in the pelage, but a note on the label states that the coat was discoloured by the firing of a lamp in the drying shed. It may be noted, however, that the normal grey of the under side is unaltered. In this younger specimen the area behind the eyebrows is uncovered by the cap, its hairs being directed outwards and backwards.

This specimen closely resembles in its brownish tint a young male shot at Kala Oya, N.C.P., in May; and here also the fore part of the forehead is uncovered by the cap. The forehead is similarly

uncovered in a sub-adult female, weighing $6\frac{1}{2}$ lbs., shot at Tammanewa in May; but this specimen is as brightly coloured as the Mankeni series.

The specimens so far described carry no convincing evidence of seasonal colour-change, bright typically coloured reddish-orange tinted specimens being met with in April, May, July, the end of September and the beginning of October. But such evidence is supplied by two examples obtained at Maha Oya in the Eastern Province in August. A sub-adult male, weighing 9 lbs. shot on August 12, has a good deal of the typical orange hue on the thigh, but the coat on the back is short and coarse and dark olive-brown in hue. Beneath it, however, the new coat, with characteristic orange speckling, may be seen sprouting. A younger male, shot on August 17 at the same place, shows the same phenomenon but is redder on the loins and thighs. The cap and fringe on the head in these examples are respectively very similar to those of the adult males and the baby from Mankeni.

Passing reference may here be made to an immature female from Hambantota on the coast of the Southern Province, received many years ago from the Colombo Museum. It is a dark coloured monkey recalling in colour and the uncovered brow the example from Cheddikulam at the northern end of the island. In the tolerably uniform dusky tint of the long radiating hairs of the 'cap', this Hambantota example resembles those described above from the northern and eastern parts of the island; but two other specimens from the Southern Province differ considerably from it in that respect and from each other in other particulars.

An adult, or sub-adult, female from Ranna, collected on May 17, has a large area of the forehead behind the eyebrows covered with short backwardly directed hairs of a yellowish grey hue, and the long radiating hairs of the anterior half of the cap are buffy throughout, a little paler at the tips, and contrasted with the duskier radiating hairs of the hinder half of the cap. The hairs of the neck, shoulders and arms are, moreover, paler than usual, being golden buff rather than orange or red, and these areas are brighter in tint, not duller, than the hinder part of the back.

A young half-grown male, weighing $4\frac{1}{2}$ lbs., from Kottawa on the coast of the Southern Province, is very different from the example from Ranna and in general colour recalls the specimens from Mankeni, but is more brightly tinted, the orange red being everywhere much in evidence in the long coat, and the bases of the hairs are blackish grey. The forehead too is covered to the eyebrows by a fringe of forwardly directed hairs as in the full-grown male examples from Mankeni. But the hairs of this fringe are bright orange throughout; and the long cap of radiating hairs is markedly two-coloured, the hairs of the anterior half being bright orange buff throughout, whereas those of the posterior half are greyish with buff tips and contrast markedly in tint with the hairs of the fore-part, an exaggeration of the same feature exhibited by the Ranna specimen.

An adult female collected by W. W. Phillips on January 15 at Anasigalla Matugama in the Western Province, also, has the

anterior part of the cap all buff as in the Ranna and Kottawa specimens. The coat is long as in the Kottawa specimen, but it is only conspicuously red on the loins and thighs, the fore part of the back and the neck being dull brownish, much darker than in typical forms.

Finally, the flat skin of an adult male obtained by Major E. W. Mayor at Roygam Korali, in the Western Province, resembles the example from Kottawa in all essential particulars, i.e., the colour of the cap, the intensification of the orange redness everywhere and of the deep bluish black of the basal part of the hairs. Unfortunately it is undated and unmeasured.

I have described these specimens at some length to illustrate the great variability of the species in colour and in the growth of the hair on the top of the head, two features by which it has been claimed that *M. sinica* may be distinguished from *M. radiata*. The specimens show that the general hue of the body may be almost identical with that of the Indian species, and that the forehead behind the eyebrows may resemble that of *radiata* in the direction of growth of the hairs.

All that can be said of the differences between the two species so far as these features are concerned is that in *M. sinica*, there always seems to be a certain amount of orange-red on the thighs, and that the short-haired area between the eyebrows and the 'cap' is at all events on the average smaller than in *M. radiata* and seldom exhibits so conspicuous a median parting.

The following table shows the weights and measurements, taken in the flesh, of some adult or almost adult examples of *M. sinica* :—

Locality and Sex				Head & Body	Tail	Total	Weight
Cheddikulam, ♂ ad.	...	...	...	1' 6 $\frac{3}{8}$ "	1' 10 $\frac{3}{8}$ "	3' 4 $\frac{1}{2}$ "	10 $\frac{1}{4}$ lbs.
Mankeni, ♂ ad.	...	...	...	1' 7 $\frac{1}{8}$ "	1' 11 $\frac{3}{8}$ "	3' 6 $\frac{3}{8}$ "	12 lbs.
Mankeni, ♂ ad.	...	...	...	1' 5 $\frac{3}{8}$ "	1' 9 $\frac{3}{8}$ "	3' 3 $\frac{1}{8}$ "	10 lbs.
Kala Oya, ♂	...	...	...	1' 5 $\frac{3}{8}$ "	1' 8"	3' 1 $\frac{3}{8}$ "	9 lbs.
Wellawaya, ♀	...	...	...	1' 4 $\frac{1}{8}$ "	1' 10"	3' 2 $\frac{1}{8}$ "	...
Ranna, ♀	...	...	...	1' 4 $\frac{1}{8}$ "	1' 7 $\frac{3}{8}$ "	2' 11 $\frac{1}{8}$ "	...
Matugama, ♀	...	...	...	1' 4"	1' 10"	3' 2"	...

Although the available skins of adult examples of this species is small, this table, when compared with the table on p. 279, bears out the claim put forward by Kelaart that the Ceylonese species is smaller at least on the average than its Indian ally.

I agree with Blanford that there is no character by which the skulls of *M. sinica* can be distinguished from those of *M. radiata*. In both species, the skulls are liable to a good deal of individual variation.

The following table gives a few of the dimensions in millimetres of some of those that I have examined :—

Locality and Sex	Total Length	Zygom. Width	Orbital Width	Upper Molars	Lower Jaw
Koliyagalla, ♂ ad. ...	117	78	67	30	83
Manken, ♂ ad. ...	112	...	...	27	81
„ ♂ ad. ...	110	79	62	31	82
Tellula, ♀ ad. ...	96	64	52	27	68
Matugama, ♀ ad. ...	95	...	...	27	...

These skulls bear out the evidence supplied by the skins that the average size of *M. sinica* is less than of *M. radiata*.

The two skulls from Manken differ considerably when viewed from the front. In the smaller the orbits are circular, measuring 21 by 21 mm., and the orifice of the nostrils is 11 mm., whereas in the larger the orbits are noticeably wider than high, being 21 by 17 mm., and the aperture of the nostrils is 14 mm.

Revising the facts, set forth above, relating to the coloration of examples of this species obtained in various parts of Ceylon, it must be admitted that many of the variations must be set aside as unexplained until more specimens come to hand.

The evidence, however, supports three conclusions :—

- (1) The two specimens from Maha Oya show that the moult begins in August and is accompanied by a marked change in colour when the old brown coat is replaced by new hair with conspicuous orange annulation yielding the red tinge characteristic of typical *sinica*.
- (2) There is a general increase in the redness of the pelage from north to south, the difference in colour between the adult males from Cheddikulam and Roygam Korali being very striking.
- (3) It also seems that examples from the south-western part of the island differ from those from the northern and eastern parts by the tint of the radiating hairs of the cap, a feature particularly noticeable in the very rich red specimen from Roygam Korali, in which the hairs of the anterior half of the cap are noticeably reddish from base to tip.

These facts I think supply evidence for the existence of three distinguishable local races of *sinica*, a conclusion enforcing a decision regarding the coloration of the cap and coat in typical *sinica* for which unfortunately no locality was known. Reliance must in consequence rest upon the descriptions of the Macaque monkey Buffon described as 'Le Bonnet Chinois' to which Linnæus gave the name *Sinica* under the mistaken belief that it came from China. By both Schreber (*Die Säugeth.* I, p. 108, 1775) and Audebert (*Hist. Nat. Singes*, Fam. 4, sect. II, p. 17, 1799), this

monkey was described as red; but neither their descriptions nor their coloured plates indicate that the cap, or bonnet, of radiating hairs was anything but uniformly coloured throughout. I propose, therefore, to restrict *sinica* as a subspecific term to the red examples with uniformly tinted bonnets with dusky buff-tipped hairs. The examples above described from Mankení and elsewhere farther south in the eastern part of the island may be taken as representative of this race.

The two new races I propose to admit may be named and described as follows:—

Subsp. *inaurca* nov.

Resembling the typical form *sinica* in having the hairs of the anterior and posterior halves of the bonnet alike in colour, but distinguishable by the absence of red from the pelage, apart from the outside of the thighs, the general hue of the head, shoulders, back and arms being yellowish olive, the hairs being merely annulated with greyish buff.

Locality and history of type: Cheddikulam (N. P.), north of Adams Bridge. An adult male collected by Major E. W. Mayor.

Since this example was killed in November, just after the August-September moult, the absence of yellow or orange annulation in the hairs cannot be assigned to fading. A second, younger example, also killed in November at Cheddikulam, similarly lacks the red speckling, but is browner than the type. The skin, however, is said to have been artificially discoloured. A still younger specimen shot in May at Kala Oya to the south of Cheddikulam is also brown without red speckling; but at Tammanewa, near Kala Oya, the red race occurs.

The likeness in colour between this northern race of *sinica* and the Indian *M. radiata* is interesting.

Subsp. *aurifrons* nov.

Resembling typical *sinica* in the redness of the pelage but brighter coloured, the hairs long, almost purplish black at the base with bright orange-red tips, the arms comparatively brightly speckled to the hands, the outside of the thighs and lower leg almost fiery red, the feet yellow. Hairs of the bonnet very long, those of its anterior half reddish from the base to the tip, of the posterior half dusky greyish at the base, reddish at the tips.

Locality and history of type: Roygam Korali (W. P.) Flat skin of an adult male sent by Major E. W. Mayor, but undated and unmeasured.

A young male from Kottawa (S. P.) agrees very closely with the type in its long coat of bright red and deep black hairs, and it has a frontal fringe wholly golden red throughout. This fringe is concealed in the flat skin from Roygam Korali.

Examples from Ranna and Anasigalla Matugama also have the hairs of the fore half of the bonnet of a uniform colour, without dusky bases, thus differing from the hairs of the hinder part; but they show none of the vivid coloration of the two specimens

THE LONG-TAILED MACAQUE MONKEYS

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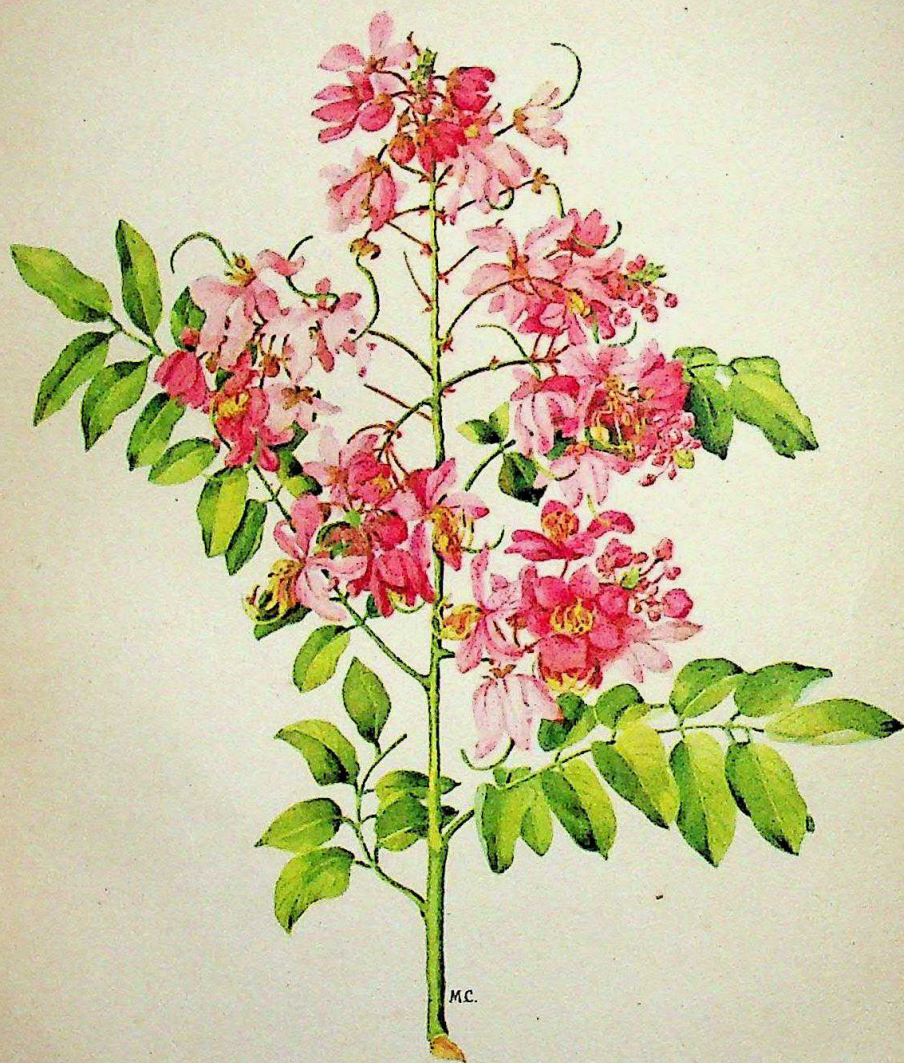
assigned to *aurifrons* and cannot at present be certainly included in the sub-species.

SUMMARY.

The following analytical key setting forth the distinctive characters of the different kinds of long-tailed Macaques from South India and Ceylon will serve as a summary to this paper.

- A. Hairs on the cheek growing upwards from the throat and lower jaw to the level of the top of the ear, or nearly so, not forming a whorl on the cheek; typically a larger short-haired area between the bonnet and the brows; red usually absent from the pelage, never specially in evidence on the outside of the thighs; size on the average larger ... *Macca radiata*.
- (a₁) General colour of the winter coat brown or olive-brown, at most faintly speckled, fading to buffy or greyish brown before the summer moult; hairs on under side whitish grey; skin of belly blackish. Subsp. *radiata*.
- (a₂) General colour of the winter (Nov.) coat much paler, markedly buffy throughout; hairs of under side pale cream; skin of belly pallid, without dark pigment ... Subsp. *diluta*.
- B. Hairs on cheek in front of ear growing downwards and backwards and forming a distinct whorl on the cheek where they meet the upgrowing hairs from the throat and lower jaw; hairs on the forehead very variable but typically a shorter area of short hairs between the bonnet and the brows; pelage usually ticked with yellow or red, always so on the outer side of the thigh; size on the average smaller... *Macaca sinica*.
- (b₁) General colour brownish olive, annulation of hair yellowish brown, not bright; hairs of the bonnet alike throughout ... Subsp. *inaurea*.

- (b₂) General colour much brighter, annulation of hair orange, yellow or red, altogether more vivid
- (c₁) Long radiating hairs of the bonnet all alike, greyish at base with buffish tips; hairs of the back not so black at the base or red at the tips Subsp. *sinica*.
- (c₂) Hairs of the anterior half of the bonnet uniformly reddish from base to tip, strongly contrasted with those of the posterior half; hairs of the back redder and blacker Subsp. *aurifrons*.



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THE JAVA CASSIA
Cassia javanica, Linn.
(about $\frac{1}{2}$ nat. size)

SOME BEAUTIFUL INDIAN TREES.

BY

E. BLATTER, S.J., Ph.D., F.L.S., AND W. S. MILLARD, F.Z.S.

PART VII.

(With two coloured plates, three black and white plates and 7 diagrams.)

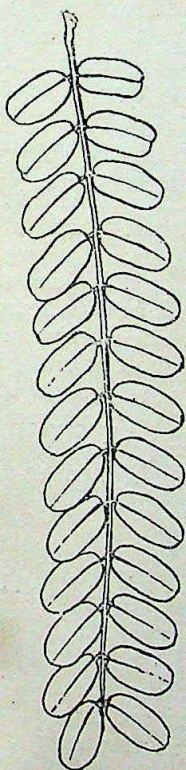
(Continued from page 65 of this volume.)

THE JAVA CASSIA.

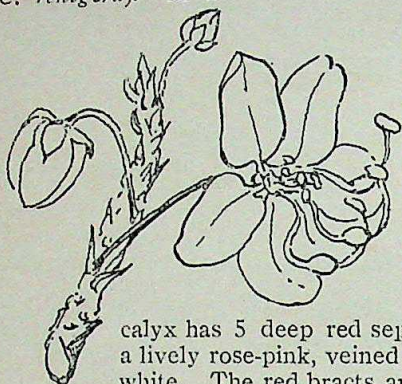
Popular names : Java Cassia, Javanese Cassia (Engl.); Dulang.

Cassia javanica Linn. Sp. Pl. (1753) 379.

Description : Roxburgh describes this Cassia as the most beautiful he has ever seen. It is a medium sized tree. Its straight trunk, covered with smooth, dark brown bark, supports a spreading crown of sturdy, horizontal branches and numerous, drooping feathery-leaved branchlets. The leaves are from 6 to 12 inches in length. At the base of the leaf-stalk is a crescent-shaped stipule. Its lower half is narrow, the upper half is broader with a spur in a notch at its apex. A large leaf is composed of from 8 to 14 pairs of leaflets; on the smaller leaves growing on the lateral flower-bearing branchlets there may be no more than 2 to 4 pairs. These leaflets are 1 to 2 inches in length and about half that in breadth. They are all very short-stalked, oblong-oval in shape and rounded or blunt at the tips. There is much variation in the shape of the leaflets, mostly they are blunt at the apex but in some this character is less pronounced. In texture they are smooth and silky, the under surface being covered with a mat of downy hairs. They are quite glossless. Leaf fall commences in December, some of the leaves turn a bright yellow; by February most of the branches are bare—their only ornament is the blackened seed pods. The soft tender green leaves come out in May together with clusters of deep pink buds. The buds are grouped in whorls at the end of short, lateral branchlets. These presently opening form lovely bunches of rose-pink flowers. In its crown of tender green leaves and flower laden branches the Java Cassia is indescribably beautiful. The distinct clusters of flowers intermingled with the foliage is a character which distinguishes the flowering of this Cassia from the Pink Cassia



(*C. renigera*). In the latter the flowering branches are leafless.



Except for a few leaves at the extremity they are covered with a flow of pink and white blooms in which the individual clusters are not readily discernible. In *Cassia javanica* each cluster of flowers contains about 10 blooms growing on long, slender stalks. At the base of each stalk is a leafy, dull-red heart-shaped bract. The

calyx has 5 deep red sepals. The oblong petals are of a lively rose-pink, veined in deeper pink. They fade to white. The red bracts and sepals, the deep pink buds, the pink and white of the petals give the clusters a lively, variegated appearance. There are 10 bright yellow stamens. The 3 lower stamens are long and prominent. They project in a double curve, swell out markedly in the middle and then bend inwards. They are crowned with large brown anthers. The anthers on the smaller stamens are yellow. All of them are fertile. The style is green.

The pods grow from 15-24 inches in length; externally they differ in no way from those of the Indian Laburnum (*Cassia fistula*). The only distinguishing feature is the soft sweet pulp of *C. fistula*. In a pod of the Java Cassia the space between the partitions—there are 70 to 80 of them—is filled with a spongy mass in which there is a roomy cell for a flattened seed, the size of a pea, smooth and of a shiny brown colour.

Flowering season: The tree flowers in May and by mid June the height of the flowering season is past and the ground below the tree is strewn with fallen petals. The seed pods ripen about February. This is another of the beautiful trees which, during the hot weather, brighten the roadsides and gardens of Bombay where it was introduced about the year 1910. Mr. Kemball was prominent in introducing it. Unfortunately the tree has not a long life.

Distribution: A native of Sumatra and Java. Planted in the Peninsula, in Calcutta and Bombay, very likely elsewhere.

THE BUSUK-BUSUK.

Popular names: Busuk-Busuk, Turucop Bumi, Sibsuk (Malay Peninsula); Gnoothein (Burm.).

Cassia nodosa Ham. in Roxb. Hort. Beng. (1814) 31.

The term *nodosa* means a node. It alludes to a character in the 3 longer stamens of the flowers of this tree which are spherically thickened in the middle. The character is present in the flowers of some other species of the genus.

As this *Cassia*, in common with the Java Cassia, is frequently planted on roadsides and in gardens, we give here a description which emphasises the points of distinction between these two trees which are very similar in general habit.



The Java Cassia (*Cassia javanica*) trees in flower at the Royal Bombay Yacht Club.

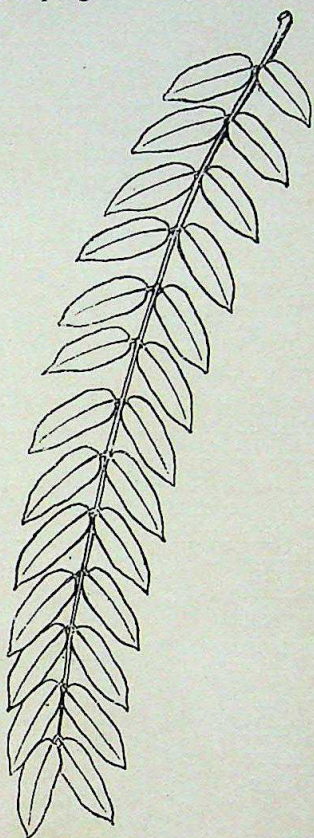


Flowers and leaves of *Cassia javanica*, Linn. Note the blunt tips of the leaflets.



Flowers and leaves of *Cassia nodosa*, Ham. The leaflets are more oblong and pointed than in *Cassia javanica*.

Cassia nodosa grows to a larger size than the Java Cassia. Like the Java Cassia, it has a crown of spreading branches with numerous drooping feathery-leaved branchlets. The leaf is about from 6 inches



to a foot in length. It is composed of from 6 to 13 pairs of leaflets without an odd terminal leaflet. The base of the leaflet is oval but towards the apex it narrows and becomes almost lance-shaped. The leaflets of the Java Cassia are blunt or rounded at the tips. Another point of distinction is the texture of the leaflets. Those of the Java Cassia are glossless, slightly downy below. They have a silky feel. The leaflets of *C. nodosa*, when full grown, are smooth and leathery in texture with a glossy upper surface. Like the Java Cassia, the flowers come out in big distinct clusters. These clusters, grouped along the branches in pairs or solitary, grow from the axils of the leaves or more usually above the scars of the fallen ones. The flowers and buds are of the same bright pink colour and display the same tendency to fade white. They are set in whorls at the end of a short branchlet. The points of distinction are: The flower of *C. nodosa* has a velvety calyx with green sepals, in *C. javanica* the calyx is smooth and the under surface of the sepals is deep red; the petals of the former are more sharply pointed at the tips than in the Java Cassia; finally the leafy bracts at the base of the flower stalks are distinctly heart-shaped in *C. javanica* while in *nodosa* they are narrow and lance-shaped. The flowers have 10 very unequal stamens. The lower 3 are the longest, each with a distinctive globular swelling in the middle. These nodes in the middle of the stamens give the tree its name, but this character is also present in the flowers of *C. javanica* and in other Cassias. The pods are similar in both trees. Those of the Java Cassia are said to grow longer, reaching from 18 to 24 inches while the pods of *C. nodosa* are from 12 to 18 inches in length.

Flowering season : May and June.

Distribution : Burma, Chittagong, Malay Peninsula, China, Sumatra, Borneo.

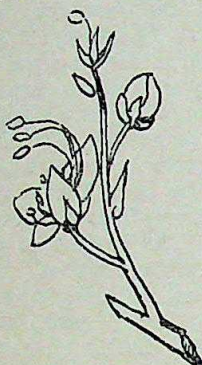
THE RED CASSIA.

Popular names : Red Cassia; Vakal (Tam.); Kada konna (Mal.).

Cassia marginata Roxb. Hort. Beng. (1814) 31.—*C. Roxburghii* DC.

Description : A rather small, round-shaped tree, growing about from 15 to 20 feet in height with slender, downward curving branches. Less robust in appearance than the Cassias previously described, the

Red Cassia is uncommonly beautiful at all times, particularly when in full flower. The leaf is composed of from 10 to 20 pairs of leaflets. They are leathery, smooth above and blunt at the tips. The flowers appear in small single clusters growing from the axils of the leaves,



on the young twigs of the year. There is a great profusion of them covering the upper surfaces of the drooping branches. The petals of the flowers are terra cotta red with fine green veins, deeper in tone on the under surfaces. The older blooms are very bright pink. The 2 lower petals of the flower are usually the largest, though the flower itself is small, the petals not being more than half an inch in length. All the stamens bear anthers. The 3 upper-most are the longest, they protrude and curve inwards and are crowned with dark red anthers. They have no swelling in the middle as with the stamens of *C. nodosa* and some of the other species. In the centre there are 4 much

smaller stamens with bright red anthers and 2 lower stamens. These 2 are the smallest. They bear yellow anthers. The sepals are salmon pink. There are pale green bracts at the base of the flower stalks. The pods are cylindrical, 8-12 inches long with transverse partitions.

Flowering season : The Red Cassia commences to flower in May though the height of the flowering season is June when the trees are smothered with their little red flowers. The seed pods are ripe in March and April.

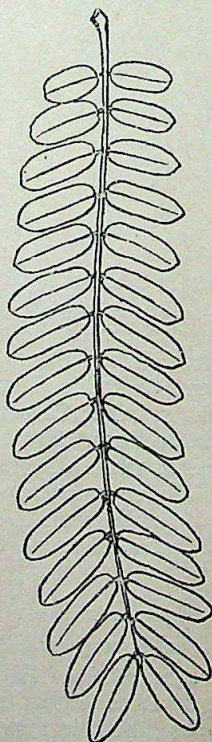
Distribution : The Red Cassia is a native of Ceylon. It was introduced in the Royal Botanic Gardens at Calcutta in 1802. It is a common tree in South India from South Arcot to Travancore and in the forests of Mysore and the Carnatic. It is not uncommon in Bombay gardens. There are a number of fine specimens in the grounds of St. George's Hospital originally planted by Lt.-Col. Dimmock.

THE HORSE CASSIA.

Popular names : Horse Cassia, Pink Shower

Cassia grandis Linn. f. Suppl. 230.

Description : The Horse Cassia is common in Bombay. It is a small tree with deep green foliage. The terminal leaflets on the younger leaves have a coppery tinge which is very distinctive. The leaves are velvety to the touch as they are finely hairy above and below. A leaf contains from 10 to 20 oblong leaflets abruptly rounded at both ends. The flowers are rose coloured; they grow in the axils of the leaves in drooping racemes. There are no





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THE SACRED BARNA.
Cratæva nurvala, Ham.
($\frac{1}{2}$ nat. size)

bracts at the base of the flower stalks. The pod is 3 inches or less in length, compressed, cylindrical, smooth, and transversely wrinkled.

Flowering season : The Horse Cassia flowers in February and March when it has lost its foliage.

Distribution : A native of Tropical America; grown in many tropical countries.

Cassia multijuga Rich.

This is a small South American Cassia which was introduced into Bombay from Peradeniya, Ceylon. Its leaves contain from 20 to 25 pairs of oblong-elliptic leaflets, hence the name *multijuga* which means many pinnæ or leaflets. The leaflets are a bright green above and very pale, almost white below. The tree bears masses of bright yellow flowers during August and September when it is in full leaf. This is the latest flowering Cassia. The cycle commences with the flowering of the Horse Cassias in February and ends with this species in September.

We append here a key which will help in distinguishing the various species of Cassias we have described.

- A. Bracts very small falling off long before the flowers appear.
 - 1. Leaflets few, large, smooth, in distant pairs. *C. fistula*.
 - 2. Leaflets many, hairy, in closely approximate pairs ... *C. grandis*.
- B. Bracts conspicuous persisting till the flowers open.
 - a. Leaflets 6-14 pairs. Racemes lateral :
 - 1. Leaflets pointed at the tips; smooth ... *C. nodosa*.
 - 2. Leaflets rounded at the tips, hairy below. *C. javanica*.
 - b. Leaflets 8-20 pairs. Racemes growing from the scars of the fallen leaves ... *C. renigera*.
 - c. Leaflets 10-20 pairs. Racemes growing in the axils of the leaves on the young twigs of the year ... *C. marginata*.
 - d. Leaflets 20-25 pairs ... *C. multijuga*.

THE SACRED BARNA.

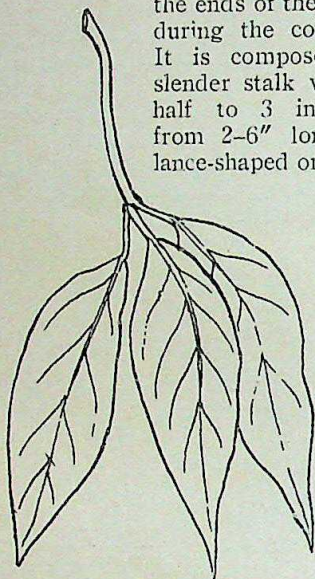
Popular names : Barna, Barun, Bilasi, Bila, Biliana (Hind.); Barun, Tikto-shak (Beng.); Tailudu, Bumboronda (Mehi); Purbong (Lepcha); Barna, Barnahi (Pb., Raj.); Bela, Bel (C.P.); Vayavarna, Bhatavarna, Hadavarna, Kumla, Waruna, Karvan (Bomb.); Kumla, Karwan (Mar.); Maralingam, Marvilina, Narvala (Tam.); Nirvala, Vitusi (Kan., Mal.); Uskia, Usiki Manu, Ulimidi, Urimidi, Urumitti, Tella ulimidi, Tellavule (Tel.); Nirujani (Coorg); Kadet, Katat (Burm.); Varuna, Asmarighna (Sans.); Roxburgh says that it is the Tikta-shaka of Sanskrit writers.

Crataeva Nurvala Ham. in Trans. Linn. Soc. XV (1827) 121.—*C. religiosa* ¹ Forst. var. *Nurvala* Hook. f. & Th. in Hook. f. Fl. Brit.

¹ Our plant has been known under the name of *C. religiosa* for a long time. This, however, is a Polynesian tree and totally different from the Indo-Malayan plant which has to be called *C. Nurvala* Ham.

India I, 172. (*Capparidaceæ* or Caper. family). (*Cratæva* after Cratevas, an obscure writer on medicinal plants, not at the time of Hippocrates, but at the beginning of the first century B.C., since he named a plant after Mithridates. Nurvaia is an Indian vernacular name.)

Description: The Sacred Barna is a small tree with a much branched head of glossy foliage; its leaves clustering mainly towards the ends of the branches. The tree sheds its leaves during the cold weather. The leaf is trifoliate. It is composed of 3 leaflets growing on a long slender stalk which may be from an inch and a half to 3 inches in length. The leaflets are from 2-6" long. Their shape varies from oval to lance-shaped or they taper to a fine point. They are

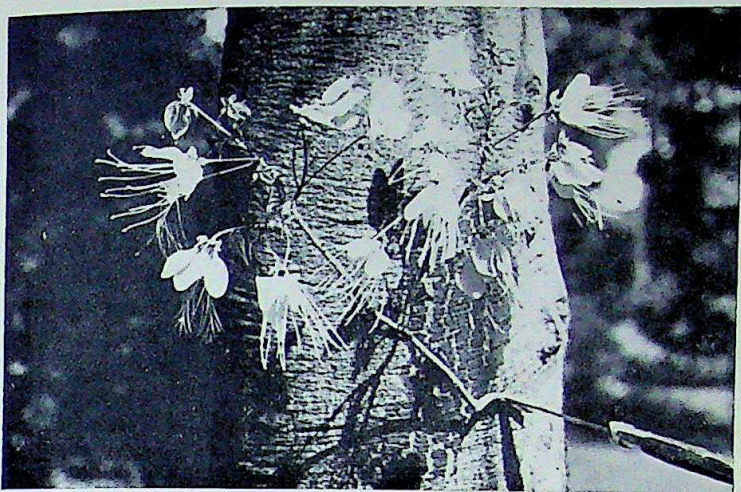


covered with a net work of veins, smooth on both surfaces, glossy above and pale, almost white below. The young leaves appear with or sometimes before the flowers. The tree is very handsome when profuse in bloom. The flowers grow in dense greenish-white clusters at the ends of the branches. Each cluster is borne upon a sturdy stalk. The sepals of the flower are small, oval and pointed at the apex. They are green when young; fading to pale pink or yellow. The white petals also fade to yellow. They measure

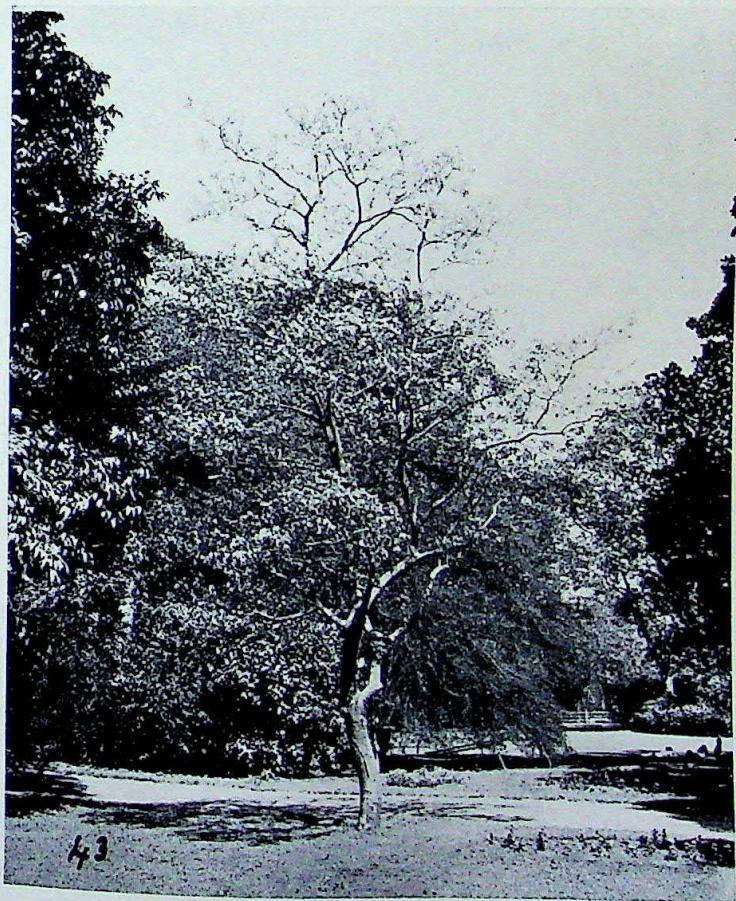
1 by $\frac{3}{8}$ inch. There is a very narrow claw petal $\frac{1}{4}$ inch in length. A bunch of long, thread-like spreading stamens protrude from the flower. They are much longer than the petals and purple or white when young, lilac when old. The Sacred Barna is one of a class of plants which is called gynophorous, which means that it bears its ovary at the end of a long stalk. The gynophore in the present species appears like a lilac thread 2 inches long with the swollen ovary at the tip. When the petals fall away the thread-like gynophore remains; it thickens and bears a globose woody fruit which contains numerous brown, nearly smooth seeds.

Distribution: Throughout most parts of India and Burma, wild or cultivated. Often found along streams, but sometimes occurs almost gregariously on dry, deep boulder formations in the





Flowers of the Sacred Barna (*Crataeva Nurvala* Ham.).



The Sacred Barna (*Crataeva Nurvala*, Ham.)

sub-Himalayan tract from the Ravi eastwards. A favourite tree near temples and tombs. It is a common tree in Bombay where it is known as the 'Wai-warna'.

Leaf-shedding, Flowering and Fruiting: The tree is leafless in the cold season, the new leaves appearing in February and March. The handsome lax-clustered flowers, white, turning yellowish or pale pink, having numerous prominent stamens with purple filaments, appear in March-May (December-April in southern India?), and the fruit, a hard-rinded many seeded berry, 1-2 inches in diameter, ripens in the rains (about August in northern India). The seeds are about $\frac{1}{2}$ inch in diameter, somewhat compressed, helicoid-reniform or irregularly circular, dark brown; testa hard but splitting readily along a suture round the seed.

Gardening: Although often found in moist shady places the tree is more a light demander than a shade-bearer. It is partial to loose deep alluvial soil near streams, while its long taproot enables it to grow on deep boulder formations where water is at some depth. It is sensitive to frost, at all events in its early stages. It produces root-suckers freely.

Two conditions favourable for natural reproduction are bare ground and sufficient moisture. Seed scattered in grass or among weeds both on moist and on dry ground, or in dry situations on bare soil, persistently failed to germinate, while if scattered on moist bare ground it germinated both in the open and under dense shade, though in the latter case the shade soon killed off the seedlings.

Seed should be sown at the time of ripening, in the rains, on deep loose soil kept sufficiently watered, or in deep pots or boxes, and transplanted during the following rains. The seed may not germinate, even if kept regularly watered, until about May or June of the year after sowing, in which case the plants will be ready for transplanting about August or early September; they are then ordinarily about 3-6 inches high. Owing to the long taproot care is necessary in transplanting.

Uses: Wood yellowish white, when old, turning light brown, moderately hard, even-grained. Used for drums, models, writing-boards, combs, and in turnery. In Trichinopoly it is also used for making planks and as firewood.

Medical uses: The bark is demulcent, antipyretic, sedative, alterative, and tonic; and the fresh leaves and root-bark are rubefacient.

The bark is useful in some cases of urinary complaints and fever, and in some mild forms of skin diseases in which sarsaparilla is generally resorted to. It also relieves vomiting and other symptoms of gastric irritation. The fresh leaves and root-bark, particularly the former, are very efficacious in all the affections in which mustard poultice is indicated.

"Bruised well with a little vinegar, lime-juice or hot water and applied to the skin in the form of a poultice or paste, the fresh leaves of *C. religiosa* (*C. Nurvala*) act as a rubefacient and vesicant so efficiently that I do not hesitate in saying that they are not only much superior to the mustard seeds in this country, but also quite equal, if not superior, to the flour of that drug imported from Europe. From

5 to 10 or 15 minutes is the time required for them to produce their full effect as a rubefacient, and if kept longer than this in contact with the skin they begin to act as a vesicant. The existence of one or two plants of *C. religiosa* (*C. Nurvala*) in each Hospital and Dispensary will certainly save them from the cost of the supply of Europe mustard for external use.

"The fresh root-bark of this plant is also a very good rubefacient and vesicant, but it is rather too dear and not procurable in large quantities. The bark of the stem is very thick (from 1 to 2 inches when fresh, and from $\frac{1}{2}$ to 1 inch when dry), greenish brown on the outer side, and grey or pale white internally and on the inner side, and almost tasteless and odourless. It is one of those barks which can easily be reduced to a coarse powder immediately after its removal from the stem". (Moodeen Sheriff).

The bark of the stem and root of this plant constitute the principal medicine of the Hindoo Pharmacopœia for calculus affections. It is said to promote the appetite, decrease the secretion of the bile, act as laxative and remove disorders of the urinary organs.

In Bombay, the leaves are used as a remedy for swelling of the feet, and a burning sensation in the soles of the feet. The leaf-juice is given in rheumatism in the Konkan, in doses of $\frac{1}{2}$ to 3 tolas, mixed with coconut juice and *Ghi*. In caries of the bones of the nose, the leaf is smoked and the smoke exhaled through the nose. The bark and the leaf pounded and tied in a cloth are used as a fomentation in rheumatism.

THE PIG-TAILED MACAQUES (*MACACA NEMESTRINA*).

BY

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In his volume on the *Mammalia of British India*, pp. 18-21, Blanford described two species of these Macaques as members of the Fauna, the first, *Macacus leoninus*, inhabiting Arakan and Upper Burma, the second, *M. nemestrinus*, Tenasserim. But owing, in a measure, to lack of material, he seems to have had no first-hand knowledge of these monkeys and his descriptions of them contain many errors due to a variety of causes into which it is needless to inquire.¹

The typical Pig-tailed Macaque (*M. nemestrina*), which is common in the animal trade and is a familiar exhibit in most menageries, is found in Borneo, Sumatra and the Malay Peninsula, but does not extend so far north as Tenasserim; and since it is not known to occur in any part of British India, it is only incidentally concerned in the subject-matter of this paper. Great diversity of opinion exists with regard to the Pig-tails which replace it in Tenasserim, Siam and Burma; and much confusion over their names and characters has arisen mainly from erroneous identifications made more than half a century ago. These are explained in the following attempt to straighten the synonymy and define the races which appear to me to be distinguishable.

By way of preface it must be stated that I agree with Mr. Boden Kloss in thinking that all the different kinds of Pig-tails, ranging from Upper Burma to Borneo, that have been named and described, belong to one species, *Macaca nemestrina*, a name given by Linnæus in ? to an example from Sumatra.

Of the British Burmese Pig-tails the first to be described and named was *leoninus*. This name was given by Blyth in 1863 to an adult male sent to him with a young specimen from Northern

¹ The skull, alleged by Blanford to be that of a very old ♀ of *M. nemestrina*, obtained by Bingham on the Thoungyeen River, Tenasserim, is the skull of a very old ♂ of the Stump-tailed Monkey, *M. speciosa*, which Blanford called *arctoides*; and the skull from Mergui, presented by Dr. Oldham to the British Museum, which Blanford also assigned to *M. nemestrina*, is the skull of an adult ♂ of the Crab-eating Monkey, *M. irus*, which Blanford called *cynomolgus*.

Arakan by Sir A. P. Phayre. The name *leoninus* was, however, inadmissible because it had been previously and very appropriately applied to the Travancore species, the so-called Wanderoo, *M. silenus*. Nevertheless, *leoninus* was used for this monkey by all writers on the Indian fauna until 1912, when Elliot set it aside and rightly substituted the inapplicable name *andamanensis*.

This name, *andamanensis*, was given in 1869 to a female Pig-tail received at the Zoological Gardens and stated to have come from Port Blair in the Andamans, its author, Bartlett, not unnaturally supposing the Andamans to be its natural home. But in the following year (*Proc. Zool. Soc.* 1870, p. 220), Capt. F. Hamilton wrote to say that there are no indigenous monkeys in those islands and that the specimen had been imported, with several others, some years previously from the adjoining mainland of Burma. He did not say whether it came from the northern or eastern mainland.¹ It might have come from either.

In 1906 two new names for British Burmese Pig-tails were introduced by Miller. One, *Macaca adusta*, was given to some specimens from Champang and Red Point in Tenasserim; the other, *M. insulana*, to examples from Chance Island in the Mergui Archipelago. To Miller belongs the credit of being the first author to show that the Tenasserim Pig-tail is quite distinct from the more southern form *nemestrina*.² But curiously enough his paper contains no reference to the extensive literature relating to *leoninus*.

Finally, in 1919 Boden Kloss gave the name *indochinensis* to some specimens from Klong Menao and Lat Bua Kao in Eastern Siam. In the same paper he stated that he had seen from Trang, in Peninsular Siam, two male specimens of the Pig-tail, of which one had all the characters of typical *nemestrina*, found at Selangore, Perak and other places in the Malay Peninsula, whereas the other approached in colour the Tenasserim form named *adusta* by Miller. From this he inferred that Trang indicated roughly the latitude where the northern and southern types of this monkey blend. Furthermore, he summarised his conclusions³ regarding the races of Pig-tailed Macaques, based partly on Miller's paper and partly on his own observations, in a tabular key setting forth their differences. This I venture to abridge.

1. Muzzle elongated; back blackened ... *nemestrina*.
2. Muzzle modified, tapering; back only slightly blackened in the middle line; annulations of hair conspicuous and markedly present over a larger area of the body.

¹ He spoke of the island of which Port Blair is the capital as "Ross Island". I cannot ascertain the authority for this, Ross Island being one of the Mergui group, where these monkeys are probably indigenous. His information regarding the monkey was extracted from a private letter and there has perhaps been some confusion about the locality of the specimen.

² It may be noted that the characters Blanford ascribed to the Tenasserim monkey were derived from this southern type.

³ It is significant that he omitted to consider the form from Chance Island, Mergui, named *insulana* by Miller.

- a. Shoulders bright russet [ex
Miller] *adusta*.
b. Shoulders tinged with dull rus-
set *indochinensis*.
3. Muzzle much reduced and shortened,
face more vertical; more annulations
in the fur; mid-line of back scarcely
blackened *andamanensis*
(=*leonina*).

Setting aside *nemestrina* which is distinguished by its comparatively immense jaws, browner general colour, with a blackish back, and typically less conspicuously annulated hair, Kloss's analysis shows that the differences in coloration between *adusta*, *indochinensis* and *andamanensis* are comparatively trivial. For reasons given below, I consider them to be inconstant and of no systematic value. As regards the skull-characters by which Kloss separated *andamanensis* from *adusta* and *indochinensis*, they too have no value because they were derived from figures, published by Anderson, of a skull taken from a Pig-tailed Macaque, which, as stated below, is quite distinct in colouring from *andamanensis* as represented by Bartlett's type of that monkey and by Blyth's type of *leonina*. It was from an examination of the skin of the latter, in the Calcutta Museum, that Kloss drew up his description of the colours of *andamanensis*. This specimen was also seen and described by Anderson in 1881 and by Elliot in 1912. It is, indeed, abundantly clear from Blyth's original description of *leonina* that this male from Northern Arakan closely resembled the Tenasserim and Siamese forms described later as *adusta*, *insulana* and *indochinensis*.

The British Museum contains a good number of specimens of these British Burmese and Siamese Pig-tails, including the type of *andamanensis*, a co-type of *indochinensis*, as well as others from Eastern Siam, several from Tenasserim and the Mergui Islands, whence the types of *adusta* and *insulana*, came, and one from Upper Burma. No two of the skins are alike, even from the same locality, as the following account of them shows.

The type of *andamanensis*, which has never been properly described, is uniformly annulated from the crown, which is not darkened, over the shoulders to the middle of the back with ochraceous buff and blackish grey, giving a yellowish olive hue, rather brighter and yellower on the shoulders, where the hair is long and somewhat mane-like. On the hind-back and loins the annulations become more obscure, the pelage here being darker olive, a little intensified in the middle line. The upper side of the tail is black and contrasted with the back. The arms are olive grey outside and annulated to the hands. The legs outside are very much the same hue but without annulations. The sides of the forehead and cheeks are grey, with the tips of the full whiskers duskiest and annulated. The under side of body and the inside of arms and legs are greyish white.

This specimen, as recorded above, came from Port Blair in the Andamans. But there is nothing in its coloration to preclude

the idea that it is the female of the form described as *leoninus* by Blyth. It is not, however, quite like the male which Blyth described as having the crown infusate, the general colour grizzled brown, the hairs being annulated dusky and fulvous, with the long mane on the shoulders strongly tinged with golden ferruginous, the middle of the back behind the shoulders darker and the tail black above with a reddish tip. This description was taken from the specimen when fresh; and since the type of *andamanensis* was presented to the British Museum in 1871 and not unstuffed and removed from the gallery till 1909, it is no doubt somewhat faded and duller in colour than when it was alive.

Anderson described an adult ♀ he shot just to the south of Bhamo in Upper Burma as resembling Blyth's type but without any darkening of the crown and with the tail yellowish brown. The only example I have seen from Upper Burma is a very old ♀ collected for the Mammal Survey by G. C. Shortridge at Hkamti in Upper Chindwin, 500', on July 26. It is very different from the female described by Anderson, being much redder, although the two localities are alike in the valley of the Irawady and less than 250 miles apart. The general colour is a uniform buffish brown, redder in patches; the head is obscurely annulated but the rest of the pelage lacks the annulation characteristic of these Macaques. The coat, however, is long and shabby, suggesting the imminence of the moult which probably occurs in July, as it does in the common Rhesus Monkey (*M. mulatta*). This may account for the absence of annulation on the hairs of the body and their faintness on the head.

From Tenasserim, whence the specimens of *adusta* came, the British Museum has an adult ♂, shot in November, an adult ♀ and her young one, shot on December 29, and a half grown female, shot on December 13, all collected at Bankachon for the Survey by G. C. Shortridge.

In the adult male the crown is only slightly darker than the nape. The hairs of the upper side are everywhere annulated with yellowish buff and brown, their bases being yellowish on the shoulders, where they are longer, grey on the back. The general tint is rather rich yellowish brown on the fore part, greyer and more olive behind, with the middle line of the back darker and tinged with greyish black, passing into the blackness of the upper side of the tail. The buttocks are markedly grey and sharply contrasted with the duskier hue of the back. The arms outside are much greyer than the shoulders, with the hairs annulated with buffish grey to the hands. The leg is greyish brown and indistinctly annulated. The cheeks and temples are mostly grey, with the hairs of the whiskers apically annulated with fuscous. The throat, chest and inside of the limbs are also grey, but the fore part of the abdomen and the lower arm are speckled with annulations.

This specimen differs apparently from the type of *adusta* in lacking the bright russet hue of the neck, shoulders and fore-back, the blackness of the crown and the light ochraceous buff of the buttocks. But I regard these merely as individual differences; and this view is supported by the colour of the adult female from Banka-

chon, the hairs of which are annulated orange and grey, the orange predominating, the whole dorsal area, except the hind-back and loins, which are duller and darkened in the middle line, being very brightly coloured, russet. The arms below the elbows are greyer than the shoulders but annulated; the legs outside are greyish brown and only indistinctly annulated.

The half grown female from Bankachon is not nearly so "russet" as the adult, the annulations being yellower; but the arms are as bright and as annulated as the shoulders. The still younger specimen is tolerably well coloured, annulated buffish yellow and brown. The youngest of all, newly born, is pallid buffish grey, without annulations.

If we set aside the youngest specimen, which has not moulted its "baby" coat, the rest of the specimens from Bankachon attest considerable individual variation in colour in the same locality.

A subadult ♂ from Sullivan's Island, Mergui Archipelago, collected for the Survey on February 31 by C. Primrose, is darker on the crown than the adult male from Bankachon and browner, not so bright on the nape and shoulders, but the buttocks are yellower and the arms exhibit brightish yellow annulation, almost lemon on the hands; the legs, both outside and inside are darker, and there is no annulation on the abdomen.

Before these Bankachon and Sullivan Island specimens are set aside, their likeness, or otherwise, to the specimens Miller described from localities near at hand in Tenasserim and the Mergui Archipelago, giving them full specific status as *Macaca adusta* and *Macaca insulana* respectively, must be considered. About *adusta* from Champang something has already been said; and since it must be presumed that the Bankachon specimens are representatives of the same race, their considerable variability in colour, both general and in detail, shows that no great reliance can be placed upon such characters as the difference between red yellow and buff or black, brown and dark annulations in the hairs, or even between the presence and absence of annulations in certain parts. The Chance Island specimens, according to Miller, differ from *adusta*, the mainland form, in having the hair on the shoulders noticeably longer than on the back, the chest and belly more heavily grizzled and the hands and the feet noticeably darker than the arms and legs. But since the male from Bankachon has the hair on the shoulders noticeably longer than on the back, this feature is not distinctive of the insular form. The example described above from Sullivan's Island differs in details from those from Chance Island and from the specimens from Champang and Bankachon on the mainland; but it does not differ more from the Bankachon specimens than they differ from each other. I cannot, indeed, find a single reliable character to distinguish these Tenasserim and Mergui Pig-tails from Blyth's Arakan specimen. By describing the shoulders of this specimen as "golden ferruginous", Blyth, I imagine, intended to convey the idea that they were the same colour that Miller assigned to *adusta*, namely "russet".

Precisely similar individual variations in colour are exhibited by the Siamese specimens in the British Museum.

An adult ♀ shot at Klong Menao in S.-E. Siam, in January, and assigned by C. B. Kloss to *indochinensis*, is greyish olive brown in general hue, with no bright yellow or red tint anywhere, the annulations, although traceable, being indistinct; the middle line of the back is slightly darkened and the hair below the buttocks is whitish.

Another adult ♀ from Klong Tundai, Tongha, December 21, is much brighter. The annulations are not sharply defined but the shoulders are bright ochraceous buff, there is more black pigment on the lumbar area, the whiskers are yellower, not so grey, the hair on the buttocks is buffy and the hands and fore-arm are clearly annulated pale greyish yellow. This specimen approaches in brightness of colour the adult ♀ from Bankachon but is not quite so russet and in poorer coat. Its coloration also recalls that of the ♀ from Hkamti in Upper Chindwin.

A female from Pak Jong in Eastern Siam (December 4), also assigned by Kloss to *indochinensis*, is brighter in tint than the female from Klong Menao, the shoulders and nape being comparatively rich ruddy yellowish buff with better defined annulations; the lumbar region and loins are darker, especially in the middle line, much as in the adult male from Bankachon and the buttocks are buffy. It is nearly intermediate in tint between the Klong Menao and Tongha specimens.

Finally, an adult male from Selok Poh in Panjang (January 22) is very like the Bankachon male but with more vivid annulations and more reddish yellow, "russet", on the shoulders, the lumbar region a little paler, the buttocks not so grey, more buffy, the whiskers whiter, with the tips of the hairs less pigmented.

Reference to Kloss's key to the races of *nemestrina* quoted above shows that he distinguished *indochinensis* from *adusta* by being duller russet on the shoulders; but, as the available specimens show, this difference of tint is of no systematic importance.

I have described these Burmese and Siamese Pig-tails in some detail to show the impossibility of dividing them into races by the characters employed by Miller and Kloss. If these characters are to be trusted the male and female from Bankachon are distinguishable forms. It is unnecessary to add anything further in justification of the following synonymy which embraces the names that have been applied to the Pig-tails ranging from Arakan and Upper Burma to Tenasserim and the adjoining districts of Siam.

THE PIG-TAILED MACAQUE OF BRITISH BURMA

Subsp. *andamanensis*, Bartlett.

Inuus nemestrinus (?) Blyth, *Journ. As. Soc. Bengal*, xiii, p. 473, 1844. Adult male (type) and young from North Arakan.

Inuus arctoides (?) Blyth, *Journ. As. Soc. Bengal*, xvi, p. 731, 1847. Alternative identification of the same specimen.

Macacus leoninus, Blyth, *Cat. Mamm. Mus. Asiat. Soc.*, p. 7, 1863. New name, but preoccupied, for the same specimens.

Blyth, *Journ. As. Soc. Bengal*, xlv, p. 2, 1875 (*Inuus*). Anderson,

Cat. Mamm. Ind. Mus., Calc. 1, p. 71, 1881. Description of Blyth's type.

Macacus andamanensis, Bartlett, *Land and Water*, viii, p. 57, 1869. Selater, *Proc. Zool. Soc.* 1869, p. 467 (woodcut ♀). Elliot, *Rev. Primates*, ii, p. 208, 1912 (*Pithecus*). Description of Blyth's type of *leoninus*. Kloss, *Journ. Nat. Hist. Soc. Siam*, iii, pp. 343-344, 1919. Description of Blyth's type of *leoninus*.

Macaca adusta, Miller, *Proc. U.S. Nat. Mus.*, xxix, p. 559, 1906. Specimens from Tenasserim. Elliot, *Rev. Primates*, ii, p. 206, 1912 (*Pithecus*). Description of Miller's type.

Macaca insulana, Miller, *Proc. U.S. Nat. Mus.*, xxix, p. 560, 1906. Specimens from Chance Island, Mergui Archipelago. Elliot, *Rev. Primates*, ii, p. 207, 1912 (*Pithecus*). Description of Miller's type.

Macaca nemestrina indochinensis, Kloss, *Journ. Nat. Hist. Soc. Siam*, iii, p. 343, 1919. Specimens from Eastern Siam.

Locality of type: Port Blair, introduced from Burma.

Distribution: Arakan and Upper Burma to Tenasserim, including the Mergui Archipelago, and the adjoining districts of Siam.

Description: General colour comparatively pale with an individual tendency to erythrism, ranging from greyish olive to buffy yellow, russet or golden ferruginous, these tints being especially noticeable on the long hairs of the shoulders which are brighter than the back, the lumbar and sacral regions being dusker especially in the middle line but never so black as the upper side of the tail, the blackness of which is sharply contrasted. The hairs of the upper side typically profusely annulated with alternating pale bands of buff or yellow or russet and dark bands of brown or black, but their distinctness varies. The annulation is less conspicuous on the back and hind legs than on the shoulders and arms and may be quite inconspicuous, especially in the old coat. Crown the same colour as the neck or darker. Cheeks greyish or buffy, the hairs of the long fringe apically annulate to a varying degree. Under side greyish white with some darker annulations sometimes on the abdomen and inside of the limbs. Buttocks grey or buffy, sometimes indistinctly annulated, sometimes sharply contrasted with the back. Usually there is a whitish fringe projecting from the lower side of the base of the tail on each side.

This race differs from typical *nemestrina* in being paler and less brown in hue, in the absence of blackish brown unannulated hairs over the greater part of the lumbar and sacral regions which are noticeably paler than the upper side of the tail in the more profuse and widely distributed annulations of the hairs of the dorsal area and the paler crown.

The skull also differs in having weaker, less produced jaws, the elongation of the jaws and their greater expansion anteriorly in *nemestrina* being correlated with the larger size of the canine teeth of the males.

The weights and measurements of some specimens of this race of macaques and some dimensions of their skulls are included in the tables at the end of this paper.

DESCRIPTION OF A NEW RACE OF PIG-TAILED MACAQUE.

From the synonymy of the race just described I have excluded references to a Pig-tailed Macaque which since 1870 has been cited as *leoninus* or *andamanensis* and regarded as belonging to the same type of monkey as the male from Arakan Blyth described as *leoninus*. Blyth was partly responsible for this. When he visited the London Zoological Gardens in 1870, Selater showed him a magnificent full grown male Pig-tail which had recently been received through the animal trade. Its locality was unknown; but Blyth at once pronounced it to be *leoninus*; and under that name it was entered. Selater published a coloured plate of it by Wolf in the Proceedings of the Zoological Society, and declared it to be the male of the female Pig-tail which had been received the year before from Port Blair and named *andamanensis* by Bartlett. Blyth's and Selater's identifications have been unreservedly accepted, although Blyth's hasty opinion was given without the possibility of close examination of the specimen or of comparison of it with his type of *leoninus* in Calcutta, and Selater's view involved the conclusion that the sexes of this Macaque differ profoundly in colour, although in other species of the genus the males and females are alike in that respect. In addition to the figure of the very dark male above referred to, in the foreground, Wolf depicted the comparatively pale type of *andamanensis* in the background. Blanford reproduced, as a woodcut, the figure of the male to represent *Macacus leoninus*; and Elliot reproduced the whole plate in colour to illustrate the characters of his *Pithecus andamanensis*.

Neither of the monkeys in question lived more than a year or two in the Zoological Gardens and both when they died were luckily sent to the British Museum where they were examined independently by Anderson and Blanford. They are strikingly different; and the male differs equally strikingly from the Arakan male described by Blyth.

So far as I am aware, Anderson was the only author who saw and described as *leoninus* both these males; but he did not state that his description of 1898 was taken from the Zoological Society's specimen; nor when he described Blyth's type in 1881 did he comment on the marked differences, which can hardly have escaped him, between the two. No author but Kloss seems to have been puzzled by the discrepancies contained in Anderson's two accounts.

Needless to say, there is no evidence that the Zoological Society's specimen came from Arakan, although the skin is thus labelled. It may have done so; but it may equally well have come, as I suspect, from some other part of northern Burma or from north-eastern India. At all events no specimen like it has been met with in Siam, the Malay Peninsula or the Sunda Islands where tolerably extensive collections of monkeys have been made. Only one other specimen resembling it has been described, namely, one stated by Elliot to have been living in the Calcutta Zoological Gardens at the time when he was compiling subject-matter for his Review of the Primates. It is a pity he did not ascertain on the spot the

locality and history of this specimen; but he gave a description of it which applies very closely to the example recorded above.

The name I propose to give to this monkey and the bibliography relating to it are as follows:—

Subsp. *blythii*¹ nov.

Macacus leoninus, Sclater, *Proc. Zool. Soc.*, 1870, p. 663, pl. xxxv. Adult male, from unknown locality, exhibited in the Zoological Gardens, London, and identified by Blyth as his *leoninus*. Anderson, *Zool. Res. Yunnan.*, 1878, p. 52. Description of skin and skull of Zoological Society's specimen, which was sent to British Museum in 1872. Blanford, *Faun. Brit. India, Mamm.*, 1891, p. 18. Male specimen with fig. copied from Sclater. Not *leoninus* Blyth, 1863.

Pithecus andamanensis, Elliot, *Rev. Primates*, ii, 1912, p. 208. In part only, pl. of ♂, copied from Sclater and description of living specimen, from unstated locality, exhibited in Zoological Gardens, Calcutta.

Macaca nemestrina andamanensis, Kloss, *Journ. Nat. Hist. Soc. Siam*, iii, 1919, p. 344. Skull only, its characters taken from Anderson's fig. of skull of Zoological Society's specimen. Not *andamanensis* Bartlett, 1869.

Type.—The adult ♂ figured by Sclater in 1870. B.M. No. (?)

Distribution.—Unknown.

Description of type: General colour very dark, the hairs distinctly annulated everywhere except on the lumbar and sacral areas and parts of the lower side and of the limbs.

Crown mostly black, its hairs dark reddish brown at the base, broadly black at the tip. Hairs of the nape and shoulders long, especially of the shoulders and fore back, conspicuously annulated with orange red and black. On the lumbar and sacral regions the annulations disappear, the distal part of the hairs being black and their bases dark brown, at least over the lumbar region, towards the rump the bases become greyish white, but when the hairs are not disarranged these areas are mainly black, showing no contrast with the black tint of the tail. At the root of the tail on each side is a tuft of white hairs continuous with the shorter white hairs of its under side; the buttocks beneath the callosities are also white. Arms externally paler than the shoulders, the hairs conspicuously annulated black and buff to the hands; internally the hairs are pale brownish to the elbow, but annulated from the elbow to the wrist. Legs darkish olive externally, the hairs annulated yellowish and deep greyish brown; foot blackish brown, the hairs not annulated; inside of hind legs brownish on the thigh, dark greyish brown and indistinctly annulated below the knee. Cheeks mostly dusky grey, annulated with greyish buff, but the crest in front of the ear dark, the apical annulations black. Throat grey, the hairs with paler and darker annulations. Chest and fore part of abdomen conspicuously annulated with yellowish and dark grey; hinder part of abdomen

¹ Named in honour of the distinguished zoologist, Edward Blyth, to whom so much of our knowledge of Indian Mammals was due.

brownish not annulated, like the inner side of the thighs and upper arm.

In the blackish colouring of the crown and of the lumbar and sacral regions, the absence of annulations on the latter areas and the identity in tint between them and the upper side of the tail, this skin resembles typical *nemestrina*; but differs in the more profuse and conspicuous annulation of the nape and shoulders, the whiteness of the buttocks and of the fringe at the base of the tail, the grey hue and annulation of the hairs of the throat and chest and the generally darker under side.

It is strikingly different in its dark coloration from all the examples I assign to *andamanensis*, although resembling typical examples of that race in the annulation of the hairs of the shoulders, the white or whitish fringe at the base of the tail and a few other points.

Anderson figured and described the skull of this specimen and published many measurements of it in 1878; but did not give its history. The information he supplied regarding it was used by Kloss, in conjunction with the colour-characters of Blyth's type of *leoninus*, to differentiate *andamanensis* from *adusta* and *indochinensis*.

The skull is that of an exceedingly well developed and oldish specimen. It differs strikingly from adult skulls of typical *nemestrina* in the shortness of its jaws, comparatively small canine teeth, elevated, massive, wide brow-ridges, nearly vertical orbits, wide zygomata and mastoids, the coalescence of the temporal ridges over the parietals and uptilted occiput.

It is clearly more like the skulls of *andamanensis*, especially in the shortness of its jaws. I have only seen two male skulls of this race, one from Selok Poh in Eastern Siam, the other from Sullivan's Island, Mergui. Neither is quite fully developed; but both show certain likenesses to the skull of *blythii*. For example, in the Selok Poh skull the temporal ridges noticeably converge on the parietals where they are only 7 mm. apart as compared with 20 mm. on the frontals; but this skull has the depressed occipital plane, backwardly inclined orbits and low brow-ridges of typical *nemestrina*. The Sullivan Island skull, on the contrary, which is a little younger, has the orbits less inclined backwards and the occiput more uptilted. This skull, I imagine, might have acquired all the peculiarities of the skull of *blythii*, if the animal had lived another ten years or so under conditions favourable to its development. There is one other point. In the lower jaw of the skull of *blythii* the coronoid process and condyle are separated by a much narrower space than in any skulls of *nemestrina* or *andamanensis* I have seen. And it is necessary perhaps to add that the skull and skeleton of this monkey show no evidence of deterioration from captivity. The animal was evidently captured when full-grown, and it lived only a very short time in the London Gardens.

In the following table are recorded the weights and principal dimensions of examples of typical *nemestrina* and of *andamanensis* taken in the flesh. The only known example of *blythii* was not measured in the flesh; but Anderson, who probably measured the skeleton, gave the following dimensions: head and body 1 ft. 11 ins.,

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tail 8 ins.; total 2 ft. 7 ins., practically the same as the male from Bankachon in the following table.

Locality and Sex	Head and Body	Tail	Total	Weight in lbs.	Name
Sarawak, Borneo, ♂ ad	2' 0 $\frac{1}{2}$ "	9 $\frac{1}{2}$ "	2' 9 $\frac{1}{2}$ "		<i>nemestrina</i> .
Tarussan Bay, Sumatra, ♂ ad.	1' 11 $\frac{3}{4}$ "	8 $\frac{3}{4}$ "	2' 8 $\frac{3}{4}$ "	30	"
Kateman River, ,, ♂ ad.	1' 9 $\frac{1}{2}$ "	7 $\frac{1}{2}$ "	2' 5 $\frac{3}{4}$ "	27	"
Perak, Malay Pen., ♂ ad	1' 10 $\frac{3}{4}$ "	9"	2' 7 $\frac{3}{4}$ "		"
Selangor, ,, ,, ♂ ad.	1' 10"	7 $\frac{3}{4}$ "	2' 5 $\frac{3}{4}$ "	25	"
Pahang, ,, ,, ♂ ad	1' 9"	9 $\frac{1}{2}$ "	2' 6 $\frac{1}{2}$ "		"
Lat Bua Kao, E. Siam, ♂ ad	1' 9"	10"	2' 7"		<i>andamanensis</i>
Selok Poh, Panjang, ,, ♂ ad.	1' 10 $\frac{1}{2}$ "	6 $\frac{1}{2}$ "	2' 5 $\frac{3}{4}$ "		"
Champang, Tenasserim, ,, ♂ ad	1' 10 $\frac{1}{2}$ "	9 $\frac{1}{2}$ "	2' 7 $\frac{3}{4}$ "		"
Bankachon, ,, ,, ♂ ad.	1' 11"	7 $\frac{3}{4}$ "	2' 6 $\frac{3}{4}$ "	18	"
Chance Island, Mergui, ♂ ad.	1' 9 $\frac{3}{4}$ "	7 $\frac{3}{4}$ "	2' 4 $\frac{1}{2}$ "		"
Sullivan's Island, ,, , ♂ subad.	1' 9"	7"	2' 4"		"
Tarussan Bay, Sumatra, ♀ ad	1' 7 $\frac{3}{4}$ "	8 $\frac{3}{4}$ "	2' 4"	16	<i>nemestrina</i> .
Tampanula River, ,, , ♀ ad.	1' 7 $\frac{1}{2}$ "	8 $\frac{3}{4}$ "	2' 3 $\frac{3}{4}$ "	10 $\frac{1}{2}$	"
Tongha, E. Siam, ♀ ad.	1' 5 $\frac{1}{2}$ "	7 $\frac{1}{2}$ "	2' 1"	...	<i>andamanensis</i>
Bankachon, Tenasserim, ♀ ad.	1' 7 $\frac{3}{4}$ "	5 $\frac{3}{4}$ "	2' 0 $\frac{1}{2}$ "	10 $\frac{1}{2}$	"
Hkamti, Upper Chindwin, ♀ old	1' 5 $\frac{1}{2}$ "	7 $\frac{1}{2}$ "	2' 1"	...	"

Notes on the table.—The adult male *nemestrina* from Sarawak was collected by the late H. C. Robinson at Sarabas. The examples from Sumatra were recorded by Miller and those from the Malay Peninsula and E. Siam by Messrs. Robinson and Kloss. The male from Lat Bua Kao is the type of *indochinensis*; those from Champang Tenasserim and Chance Island, Mergui, are respectively Miller's types of *adusta* and *insulana*. The other specimens were collected and measured for the Mammal Survey by G. C. Shortridge.

I have omitted from the table the dimensions of two females from Klong Menao and Pak Jong in Eastern Siam, assigned by Kloss to *indochinensis*, because the measurements on the labels, given in millimetres, indicate a size in excess of that of all the males recorded in the table. There was clearly some accidental error which I cannot explain.

The table shows close agreement in size between the two races, and that the tail is subject to greater variation than the head and body. Large females are not very much shorter than small males; but there is considerable difference in their respective weights.

Some skull-measurements of Pig-tailed Macaques :—

Locality and Sex		Total Length	Zygom. Width	Orb. Width	Max. Width	Upper Molars	1st Upper Molar	Upper Canine	Length of Lower Jaw	
Sarawak,	♂ ad.	161	100	82	51	38	9 × 8	12	115	<i>nemestrina</i> .
"	♂ yng.	133	82	63	44	37	9 × 9	10	92	"
Pahang,	♂ ad.	151	100	83	55	40	10 × 9	11½	110	"
Selangore,	♂ ad.	151	92	78	48	38	9 × 9	11	110	"
Perak,	♂ ad.	144	90	72	48	37	9 × 8	10½	103	"
Lat. Bua Kao,	♂ ad.	138	95	...	...	...	...	10	98	<i>andamanensis</i> .
Selok Poh,	♂ ad.	130	90	72	43	33	8 × 8	9—	93	"
Champang,	♂ ad.	136	94	...	...	...	...	...	106	"
"	♂ ad.	130	88	...	...	...	...	...	94	"
Chance Island,	♂ ad.	133	...	...	...	...	...	...	93	"
"	♂ ad.	128	...	...	...	...	...	...	97	"
Sullivan's Island,	♂ subad.	122	84	69	41	32	8 × 8	9	91	"
Loc. ?	♂ ad.	136	102	85	47	35	9 × 9	9	102	<i>blythii</i> (type).
Sumatra,	♀ ad.	134+	84—	...	...	...	...	...	93+	<i>nemestrina</i>
"India",	♀ ad.	131	85	72	...	36	...	...	...	"
"	♀ ad.	134+	84—	...	...	...	...	...	93+	"
Penang,	♀ juv.	110	73	63	...	...	...	...	76	"
Klong Menao,	♀ ad.	117	76	64	38	32	8 × 7	...	...	<i>andamanensis</i> .
E. Siam,	♀ ad.	116	76	64	39	32	8 × 7½	...	80	"
"Port Blair",	♀ ad.	115	76	64	39	34	8 × 8	...	80	"
Pak Jong,	♀ ad.	114	76	64	40	33	8 × 8	...	81	"
Bankachon,	♀ ad.	109	75	59	39	33	8 × 8	...	80	"
Hkamti,	♀ old.	104	74	58	38	35	7 × 8	...	76	"

Notes on the skull measurements.—The skulls have been arranged in approximately the same order as the skins to which they belong,

the Sarawak specimen which heads the two tables being the largest Pig-tail known to me. I have inserted the dimensions of a young skull, with the last molars only just through the bone for comparison with the adult skulls of *andamanensis* which it closely resembles in length, although, be it noted, decidedly narrower. The canine tooth is not fully erupted.

Some measurements given by Miller of Sumatran specimens agree very closely with those from Pahang and Selangore, one being a little longer, namely, 154 mm. The measurements show that the skulls of adult *nemestrina* are on the average considerably longer and have larger teeth than those of *andamanensis*; but in details they vary a good deal from each other, as attested by the differences in width, especially of the muzzle, between the examples from Pahang and Selangore.

I am able, unfortunately, to give very few complete measurements of male skulls of *andamanensis*, and one of them from Sullivan Island, is not quite full sized. It may be noted that there is a complete overlap in size between the Champang and Chance Island specimens regarded by Miller as distinct species.

The measurements of the skull of *blythii* bear out what was said above with regard to some of its peculiarities. In total length it is exactly 25 mm., one inch, less than the adult male from Sarawak, but it is actually a little broader across the cheek-bones (zygomata), the orbits and, it may be added, across the mastoids (the back of the skull behind the ears). It is almost exactly the same length as the skull from Champang in Tenasserim, the type of *adusta* Miller.

With regard to the female skulls very few measurements of typical *nemestrina* are available. Miller gives the length and breadth of two from Sumatra. The larger of these has been entered in the table; the other is a little smaller, namely, 130 by 82½ mm. The only adult female I have seen is ticketed "India". These three specimens show that females of this race are noticeably larger than females of *andamanensis*. This is borne out by the measurements of the young specimen from Penang, in which the first upper molar is only just through the bone, the second being still buried. Yet this example is about the size of the adult female from Bankachon. It is important to note that the dimensions of the skull of the type of *andamanensis*, labelled "Port Blair" in the table, are in almost punctilious agreement with Siamese skulls named *indochinensis*.

The only other skull which calls for comment is the small one from Hkamti in Upper Chindwin. This is a very old individual with the molars worn flat, the incisors dropped out and the jaws shrunken in length.

SUMMARY.

The views above stated regarding the distinguishable races of Pig-tailed Macaques (*Macaca nemestrina*) may be epitomised in the following analytical key:—

- a. The back behind the shoulders at most slightly darkened, not nearly so dark as the top of the tail which offers a strong contrast; general colour much paler; jaws short ... *andamanensis*.
- a'. The back behind the shoulders, and the crown, deep blackish brown, the same tint as the top of the tail which is not contrasted; general colour much darker.
- b. Hair generally, except on the back, profusely annulated; colour not so brown; white tuft on base of tail and buttocks white, contrasted with the loins; jaws short; brow-ridge massive, orbits nearly vertical, occiput untilted ... *blythii*.
- b'. Hair generally comparatively inconspicuously annulated; colour browner, base of tail and buttocks not white and strongly contrasted with loins; jaws long, brow-ridge low, orbits sloping, occiput depressed ... *nemestrina*.

A specimen of the Pig-tailed Macaque, which must for the present be regarded merely as a variety or mutant of *M. nemestrina nemestrina*, was captured, it was alleged, many years ago at Long Salai on the Baram River, E. Sarawak, and after living in captivity for about five years was given by the Rajah to Major F. Day who brought it alive to England where it died in 1893. Its skin was exhibited to the Zoological Society (*P.Z.S.*, 1893, p. 325), by Mr. Selater and was presented to the British Museum by Major F. Day.

Its general colour, to which Mr. Selater drew attention, is a golden brown on the upper side, rather darker in the middle of the back, the hairs being uniformly tinted and without annulations. Nowhere is there any black. But the skin exhibits a variation, unnoticed by Selater, which is unique in *M. nemestrina*. The hair on the middle of the top of the head grows straight backwards from just behind the brow where there is a short fringe of erect hairs. The head thus lacks the definite cap of hair radiating from a whorl near the centre of the crown which is found in *M. nemestrina*. The hairs on the cheek, however, are directed upwards to the sides of the crown as in that monkey. The hair-growth on the head, indeed, partakes of the characters of the two species *M. mulatta* and *M. nemestrina*; and despite the story of the capture of the specimen as a wild animal, I am inclined to regard it as a menagerie-bred hybrid between those species, an opinion supported by the colour. At all events examples of *M. nemestrina*, from the Sarawak district, which I have seen are perfectly normal in colour and hair-growth on the crown. Hence the

coincidence of two "mulattine" characters, namely, erythrism and backward hair-sweep on the crown, would be surprising in a wild specimen. Nevertheless, the skull, which is just adult, does not, I admit, look like the skull of a monkey reared from birth to maturity in captivity, unless, of course, more favourable conditions are supplied in Borneo than England. It only shows a little of the characteristic menagerie scowl and prognathism.

THE STUDY OF INDIAN BIRDS.

BY

HUGH WHISTLER, F.Z.S., M.B.O.U.

PART VIII.

(With a plate).

(Continued from page 103 of this volume.)

THE REPRODUCTION OF BIRDS.

The Nest.

However ignorant people may be of Nature and her ways there is practically no one who is ignorant of the fact that birds make nests. It is one of the most conspicuous and widely known of all the attributes of bird life. Just as the egg is one of the salient characteristics of a bird, known alike to savage and civilized man, so too is the construction of a nest to hold that egg, a corollary which is known to all. In this chapter therefore I propose to discuss some of the facts connected with birds' nests and some of the angles from which they may be considered.

We have already seen that the egg is one of the reptilian features which a bird retains from its ancestral heritage. The nest, on the other hand, may be regarded perhaps as one of the mile-stones that mark the rise of the bird above its ancestry.

On broad lines most of us are familiar with the reptile's treatment of its eggs. The snake deposits the grape-like cluster in a rotting manure-heap or in any secret hole or corner. The lizard's eggs are found within a crevice in a wall. The crocodile and turtle bury their eggs in holes in the sand. The actual site in all cases is doubtless determined largely by chance, influenced by the fairly obvious if unconscious idea of concealment. Occasionally the site may add slightly to the process of incubation. The natural generation of heat in decaying vegetation or the sun scorching the sands must have some influence on the buried eggs. In rare cases the parent guards the eggs, her presence doubtless retarding the loss of heat even if it does not serve to generate it.

But in every class of reptile the care for the egg is almost the minimum, probably much as it was amongst the great reptiles of the primeval world whom we may picture as depositing their eggs in the decaying bogs and leafmould of their sweltering world and then and there forgetting them.

But, with the slow development of the bird from the reptile, this treatment grew inadequate. As the temperature of the bird rose and it became warm-blooded, the egg must have become less automatic in its development. A higher temperature was required for the maturing of its vital germ. The call on the parent was greater and as the parent responded to the call methods, obvious and

instinctive in their beginning but with the seeds of rapid improvement within them, soon suggested themselves by which the parent could help in incubation and, in the process, add to its own safety, comfort and ease. To pull a little rubbish into a hole is an instinctive matter but it contained the germ of an idea capable of much improvement. And as the bird became gradually an arboreal creature, *pari passu* with its growing wings, it gradually shunned the dangers of the ground and the hole in which it might so easily be trapped by its non-flying relatives and enemies. The hollow and the hole on the tree trunk or the cliff face was more favoured than the ground, and the provision of the artificial hollow naturally followed.

To-day we may still see in actual use all the stages between the most primitive methods of bestowing the eggs in or under the surface of the earth side by side with the most wonderful forms of artificial nest and I propose to make a brief review of all these stages. But there is one proviso of which to warn the reader in advance. The line of development has not been either continuous or in equal measure with the evolution of the different orders of birds. The same ideas have originated in different classes. They have advanced sometimes on the same lines, sometimes on different lines. There have been sudden steps and limitations, due to the chances of environment or fate; and sometimes no doubt there have been retrogressions, sudden returns to primitive methods. The result is that the stages we shall observe have no connection with the degrees of the physical development of the birds that employ them. The fallacy must be avoided of comparing the sketchy dove's nest with the crow's far better structure and drawing from the evolution of the nest a guide to the evolution of the families. The furthest that it is safe to go in this respect, is to state that Passerine birds, as an order the most highly developed of all birds, reach the highest levels of nest architecture; or we may see and note the evolution of a particular type of nest, such as the saliva-gummed nest of the Swifts, running through the family, and reaching its highest point of success in particular species, so long as we do not attempt to correlate it with the evolution of the various members of the family.

The primary purpose of a nest is to be a receptacle for the eggs. It is in its essence and construction nothing more. Without the eggs it is meaningless to the bird. In practice it often serves to hold the young after they have left the egg. In practice it may add a little to the process of incubation, to the comfort of the incubating bird. Occasionally it is used as a shelter, and very occasionally dummy or extra nests are built as part of the normal routine of a bird's reproductive circle. But viewed in wide terms, the sole aim and function of a nest is to contain the egg.

One is tempted to believe that the most primitive nest in the world is that of the Megapodes, of which one species *Megapodius nicobariensis* is found in the Andamans and Nicobars. Although in a sense—viewed from the standpoint of human intelligence—the nesting arrangements of this bird appear somewhat elaborate, I regard it as primitive in its resemblance to that of many reptiles.

The megapode of our area lives and nests just within the dense tropical jungle that clothes the island shores at spring tide high water mark. Here in the jungle the birds collect great mounds of decaying vegetation and sandy soil. These mounds vary in size. A small one may be three feet high and twelve or fourteen feet in circumference; an average one five feet high and thirty feet in circumference. An exceptionally large one is recorded as eight feet high and sixty in circumference. Hume's account is worth quoting:—'It appears to me that the birds first collected a heap of leaves, coconuts and other vegetable matter, and then scraped together sand which they threw over the heap, so as not only to fill up all interstices, but to cover everything with about a foot of pure sand. I say *sand*, but this term is calculated to mislead, because it does not contain much silex, but consists mainly of triturated coral and shells. After a certain period, whether yearly or not I cannot of course say, the birds scrape away the covering sandlayer from about the upper three-fourths of the mound, cover the whole of it over again with vegetable matter, and then cover it over again with the sand.' The general effect is much that of a leafmould heap as prepared by any gardener. In such a heap, the bird or birds—for there is some doubt as to the number of females which use a given mound, place their eggs which hatch therein without any assistance apparently from the female. It is generally assumed that the heat generated by the decaying vegetation causes incubation. The young are hatched in a very advanced stage, feathered and able to fly, apparently extricating themselves unaided from the mound.

The similarity of this system to that of many reptiles is self-evident, except in so far as the formation of the mound is concerned. Davison indeed tells us that reptiles often use the megapode mounds and that he himself from one mound besides megapode eggs dug a dozen eggs of some large lizard.

It would be interesting to know the blood temperature of megapodes as compared with other birds. For the eggs are evidently hatched by the mere retention of the body heat with which they are laid, conserved by the superincumbent sand and vegetation; and one might hazard a guess that the megapode has still an approach to the lower reptilian temperature which finds such conditions all that is necessary for incubation. The eggs are reported to be abnormally tough in constitution. St. John records how some eggs taken were put away and forgotten, left exposed to the open air and rain and still about half of them hatched. But it must be remembered that in tropical climates air-heat is sufficient to complete the incubation of well-advanced eggs of widely differing species. All egg-collectors in India have had the experience of hard-set eggs hatching on their tables, sometimes several days after taking. In the hot, moist, primeval jungles incubation must have been far more of a spontaneous development than it is in the cooling world of to-day.

Incubation by the parent bird must have been a process long in development, marking slowly the rise of the bird from its reptilian, cold-blooded ancestry and the slow dessication and cooling of its sur-

roundings. Parental interest in the egg meant parental presence in the nest. The act of laying insensibly merged into the act of incubation. Increase the importance of an object and more attention is paid to its receptacle. The cared-for and carefully-tended egg was provided with a nest. It was one of the mile-stones to mark the progress of the evolution from the reptile to the bird.

Originally, one may presume, all eggs were placed in holes in the ground or amongst stones and rocks. White—under which term I include all dingy varieties of that colour—is the colour of all reptile's eggs, which have reached the stage of a hard shell. It is therefore doubtless the original colour and we find it to-day still amongst the vast majority of birds which lay their eggs in holes. In a hole hidden from the gaze of passing creatures the conspicuous nature of white is of no importance. Evolution has not needed to work upon it and the primitive condition remains. Eggs which are laid on the ground in the open, on the other hand, are usually well-coloured, often in patterns and colours that tend to obliterate them amongst their surroundings. The variety and the success of such patterns makes it evident that evolution has been at work in their case. For this reason one decides that the placing of the egg in a hole is a far more primitive condition than the placing of an egg on the ground.

To my mind the nesting of the Storm Petrel (*Procellaria pelagica*) is very instructive as an illustration of the supposed ancestral method of nesting. It is fresh in my mind as I saw it recently in the Mediterranean.

We landed on a tiny islet, little more than an outcrop of stone on which time and wind had collected a mixture of soil and stones with a few creeping plants. A Herring Gull standing on a rock was the only living thing in sight, save for a few scuttling lizards and the familiar snails of the Mediterranean seaboard. The gull had no nest and there was nothing else apparently to breed there. I walked round about the island and could see nothing of interest. Then I tried the sense of smell, like any other mammal. I sniffed round the crannies of rock and the piled-up heaps of stones until a sickly oily smell rewarded my search, the unmistakable smell of Petrel. Had I been a fox or a jackal, my search would still have availed me nothing. The rough stones would have foiled my digging paws. But human hands can go where other mammals fail. I lifted out a number of large stones until finally in a crevice a Storm Petrel was visible brooding the solitary egg. There proved to be a large colony of the birds packed into the crevices of the stones and rock, some brooding eggs, others waiting for the eggs to come, all drowsing away the hours of daylight.

On that islet, man was probably the only enemy that ever could rob the colony. With altered details the scene was typical of the nesting habits of many of the Petrel family and it is evident that the isolation of the sea has preserved amongst them a picture of the original method of the nesting of birds before evolution changed their habits.

There must have been variations on this habit of nesting under stones and amongst a chaos of fallen rocks. For such sites are

not found everywhere, and in the great primeval swamps and forests they must have been often lacking. So parallel with such sites we may consider a habit of pushing in amongst herbage, fresh or decayed, for concealment and the scraping of hollows in sand or loose deposits. The nesting on the ground amongst herbage is such an obvious method that we need not labour it here. The habit has continued amongst innumerable species and we find it at the present day practised still by birds with nests in every degree of evolution.

But the scraping of holes merits rather more attention. Here again we may find it profitable to consider first the case of islet nesting species.

In this connection British Ornithologists would immediately think of the case of the Puffin (*Fratercula arctica*) whose burrows honeycomb the soil in all directions so that, on the islands where they breed it is almost impossible to walk across the turf without breaking through the crust. But for Indian Ornithologists the most handy illustration is found in the case of the Crab-Plover (*Dromas ardeola*).

To quote Mr. Stuart Baker:—'Sir Percy Cox and Major Cheeseman found immense colonies of these curious birds breeding on some of the islands in the north of the Persian Gulf, those on Buna Island consisting of several hundreds of birds. The eggs are either laid at the bottom of burrows in the sandy soil—in some cases apparently dug out by the birds themselves—or they are laid in hollows amongst the loose boulders and rocks. It undoubtedly, however, prefers burrows wherever the soil is sandy and loose enough for these to be made. They are of no great depth, being anything between a foot and four feet, the extremity where the nest is being rather larger than the entrance. Only one egg is laid but that one is enormous in size compared to the bird. In colour it is a pure white, with a very smooth close texture, but not particularly hard or glossy, whilst in shape it is a long oval, slightly pointed at the smaller end . . . the birds are said to sit very close and have in some cases to be pulled out of the hollows which they refuse to quit.'

When we remember that the Crab-Plover is so primitive a species that systematists have difficulty in fixing its true affinities and position, when we regard its curious egg, I feel sure that we are entitled to regard this picture of its nesting as typical of very primitive conditions.

The principal of the burrow in the ground or in the face of a bank is not capable of much development, other than that of mere length. For some reason or other—possibly the fact that burrows are easily discovered by snakes and small predaceous mammals and that discovery often implies the entrapping of the bird upon her eggs—this mode of nesting is comparatively rare except amongst island-nesting seabirds; and those species that adopt it are often colonial in their habits.

India has a large share of the comparatively uncommon burrow nests. The Pied Kingfisher (*Ceryle rudis leucomelanura*) will immediately occur as an example of the isolated burrow. Whilst

some of the various Bee-eaters (*Merops*), the Sandmartins (*Riparia riparia*) and the Bank Mynahs (*Acridotheres ginginianus*) furnish familiar instances of colonies of burrows. The longest burrows are probably those of the Blue-tailed Bee-eaters (*Merops javanicus*); in these 7 feet is no unusual length. The Bank Mynah colonies are remarkable for the amount of inter-communication often found between various burrows. Although burrows of these types are usually driven into bank faces, some of the Bee-eaters burrow into the ground. The labour involved is shown by the wearing down of the beaks of Kingfishers and Bee-eaters and this renders all the more remarkable the burrowing of the Sandmartins whose tiny beaks are ill adapted to the task. It will be noted that in such instances the building of definite nests within the burrows is confined to Passerine birds as a rule.

Starting with the assumption that the hole is the obvious form of nest, one is prepared to believe that becoming arboreal the bird readily adopted the chance of nesting in the natural holes and hollows that growth and decay soon provide in any tree. In such holes the ancestral white of the eggs would still be retained without modification. There is some significance doubtless in the fact that the birds which lay white eggs in holes with little or no nest mostly belong to the more ancient orders. When Passerine birds breed in holes, one generally finds that the hole contains a more or less definite nest and that the eggs follow the general colour-pattern of their group. This would seem to indicate that hole-nesting amongst the Passeres is not an original but a reversional trait.

The habit of nesting in a hole in a tree lends itself to two lines of development, obvious and circumscribed though they may be. The first is excavation. The second is masonry.

Suitable holes are not always numerous, especially in young and healthy trees. The would-be tenant, therefore, disappointed of the perfect hole of his desires, naturally falls into the way of clearing out the rotted wood which has not yet quite decomposed; he gnaws the entrance hole a little larger; he attacks even the circumscribing sound wood. Finally we reach the stage of the Woodpecker which drives a perfect burrow into hard wood, just as the Bee-eater drives it into earth. But the harder material implies more drastic specialization of structure, and that the Woodpecker family exhibits.

The opposite line of development is far rarer. Only a few species have attained the mason's craft which obviously means something more like reasoning power. Two outstanding Indian examples of this immediately occur to the mind, the cases of the Nuthatches (*Sittidae*) and of the Hornbills (*Bucerotidae*). As is well known, both of these families are accustomed to plaster up the entrance holes of their nest, though on somewhat different lines.

The simpler case is that of the Nuthatches. They adopt any hole in a tree, or occasionally wall, and as the entrance is usually rather larger than their requirements, they build it up with earth and clay, which dries to the consistency of plaster, leaving only a small hole just sufficient to allow of their passage. It is, however, to be remembered that a certain number of the family, usually known as the Rock Nuthatches, represented in Baluchistan, are

accustomed to build a complete oven-shaped nest of mud on the face of cliffs, and it is possible that the nesting habits of the tree-building Nuthatches are really a retrogression, the plastering up of the holes being a relic of former habits. It is often manifestly unnecessary.

The case of the Hornbills is far more interesting. Hornbills are large birds, some of them very large. They nest in large holes in trunks and branches and the females are imprisoned in the holes, built in with a hard wall which leaves merely a wide vertical slit through which the sitting bird's beak can pass to receive food from the male who feeds entirely for her during her captivity. The plaster in this case is apparently provided by the female's own excrement and she is believed to build it up herself from within. Here the motive appears to be solely defence and one must surmise that the habit has been rendered necessary by the large size of the birds and the consequent size of the entrance hole needed. This must render the bird vulnerable to the attacks of the larger arboreal mammals, monkeys and large squirrels, which, while able to attack the sitting bird in a large unprotected hole, must surely hesitate to tear at a small loophole defended easily by the Hornbill's great beak.

Hitherto we have dealt with developments of nests in which the site was all important. Such nest holes are really independent of any constructional skill. The presence or absence of any material in the nest is really negligible. With the abandonment of the hole the full scope of evolution begins.

A complete book might be written on the subject of Indian nests alone. Here I must be content with simply recording a few of the interesting developments which occur when once the nest is freed from the trammels of the ancestral hole.

For the moment we will concentrate on the arboreal nest.

It is easy to see how the arboreal nest originated. There must have come a point in the evolution of the arboreal lizard-bird where the supply of nest holes up in trees did not equal the demand. Failing in her search for a suitable hole the breeding female was compelled—under the urgent, unconscious knowledge that her eggs were ready for laying—to accept the best substitute available, the crown of a treefern or the hollow between the branches of a tree at the spot where they leave the trunk. In such a spot to-day one may find the nest of a Tree-Duck (*Dendrocygna*) which has been disappointed of a hollow bough. Some such hollows are very suitable, others are uneven or incomplete but with the piling in of a little material can be made to serve. In such hollows rubbish accumulates, and the very dullest instinct can soon learn to shuffle the rubbish into convenient positions and add a little to it to make things more satisfactory.

I saw an example of such a case not long ago. A pair of Wood-Owls (*Strix*) were living in a tract of wooded country where careful forestry had removed all dead and dying trees. There was literally no hole in the place which provided their usual requirements. They had in consequence perforce nested in a junction of the boughs of a large tree, where a small hollow, eked out with a few roughly-

placed sticks afforded a nesting place for the eggs. The eggs were safe but when the young hatched and began to move about, their number dwindled, as chick after chick fell overboard.

Such must have been the position. Safety was for those with the greatest skill in adapting the available hollows and fencing in their sides with material to save the young from falling out. The young of the successful builders survived and evolution worked to perfect their skill. With advancing skill the choice of sites increased. Materials piled into a fork of a bough prepared a site, where had been none.

We can see this process at work any day. The ordinary cup-nest of the open Babbler-type is started by the haphazard piling of a collection of sticks, roots, fibres and grass into a convenient fork or tangle of twigs. The material is brought and dumped with no particular arrangement. Some falls to the ground. The rest catches in the twigs and accumulates, each successful piece making it progressively easy for the next piece to rest there. When there is a little pile the bird stands on it, shuffles it about, pokes ends in here and there, smoothes and rounds it by squatting down and turning about. In a short time there is the semblance of a nest. Finer materials are brought to line the cup, piled in haphazard and then smoothed into place and the structure is complete. The history of such a nest is the history of the evolution of the nest.

If a census could be taken of all the nests of all the species in the world it would certainly be found that the overwhelming majority are of this type—an open cup in which the foundations are of coarser material, growing progressively finer to the surface on which rest the eggs.

With this universal type as a starting point there are a number of modifications which for the most part, however beautiful and diverse their special characteristics, fall into well-defined types. The impelling purpose behind these modifications is always the same, the attempt to secure the maximum of safety for the eggs. Though there may be in addition, occasionally, the purpose of allowing a species to colonise a peculiar type of habitat which would otherwise not be available to it.

We must first of all in our consideration of these points avoid the common error of estimating all modifications in the light of their success as a protection against human enemies. It is so easy to say that the nest of a minivet (*Pericrocotus*) mimics an excrecence of the bough on which it is placed or that the nest of a White-browed Fantail-Flycatcher (*Rhipidura aureola*) looks like that of a hornet. These effects may be only in human eyes, viewed from the standpoint of the ground. Yet, as I emphasised under the question of protective colouration, the human enemy is under the normal conditions of Nature the most negligible of all. The various nest types were fixed long before man counted as an enemy. Now it is true man and his civilisation is a serious enemy but his influence works in other ways, without affecting established patterns.

This is no doubt the reason why birds appear so seldom to utilise protective sites other than holes. One is tempted to think that all wise birds would nest in the centre of cactus hedges, or

beds of nettles, on the tips of Euphorbia plants, or at maximum heights in trees, forgetting that although these sites are deterrent to human beings they avail nothing against the real enemies of eggs and young. There are exceptions of course. The little nest of the Rufous-fronted Wren-Warbler (*Franklinia tuchanani*) no doubt benefits from its habitual site in the matted thorns of the wild caper bush and the woodpeckers of the genus *Micropteryx*, which nest in the centre of ant colonies, no doubt are protected by their involuntary hosts. But as a general rule protection of this type is valueless as the enemy can attack by the same road used by the owner of the nest.

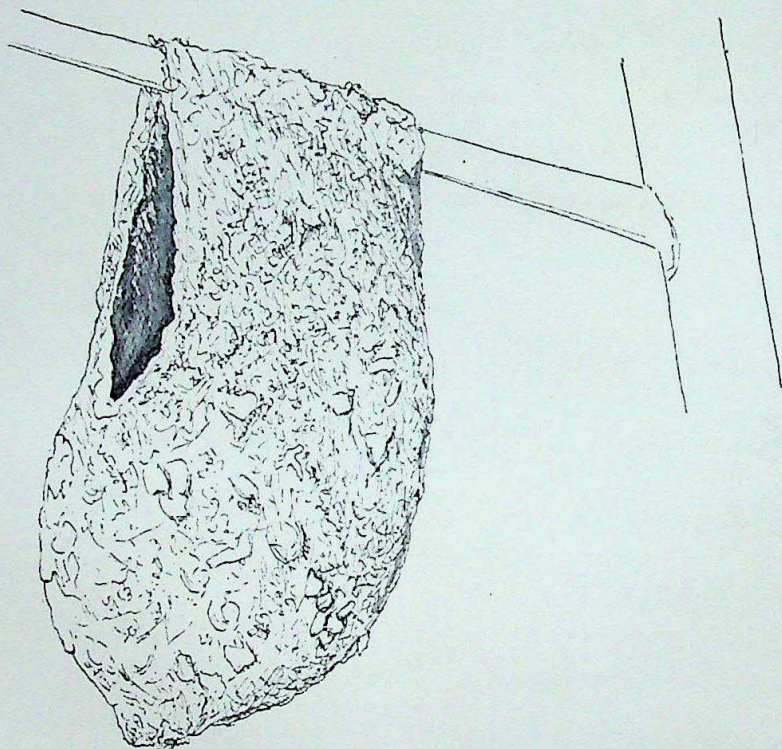
Leaving aside the most destructive of all enemies—the elements, birds chiefly require to protect their eggs against two classes of enemy, other birds and mammals and reptiles. Against birds the best protection is concealment; against mammals and reptiles this can be reinforced by difficulty of access.

The egg and chick-eating bird, of which the Indian Tree-Pie (*Dendrocitta vagabunda*) is a most familiar example, hunts entirely by sight. It probably has not even the reasoning power to watch deliberately a pair of birds to their nest. It wanders casually through the trees and bushes collecting a miscellany of food, finding what its keen eye lights upon. From below or sideways it may or may not recognise a nest—but certainly the eggs are most in danger at the angles from which they are visible. Invisibility is clearly the best protection and in the absence of the sitting bird this is best attained either by the doming over of the nest or by the obliterative colouration of the eggs.

Colouration and pattern are certainly far more of a protection for eggs and young than they are for adult birds. In ground-nesting species this is self-evident. In other cases one must not expect the eggs to match the nest when viewed in the open at close quarters. The effect to be appreciated is that of the nest and eggs viewed through a vista of boughs and leaves and glancing lights and shades. From such an aspect even the white eggs of a dove, on their sketchy light-admitting platform, fade away in the patterns of Nature.

The climbing mammal and reptile can be more easily foiled by placing the nest in situations where they are less likely to reach. Such an effect is attained by the Orioles (*Oriolus*) and the King Crows (*Dicrurus*) which build at the ends of the side-boughs of trees and the Shrike-Tits (*Pteruthius erythronotus*) which build on the topmost twigs of high trees. But such situations in turn render the eggs more liable to damage from the wind and the nests are therefore modified into the well-known hammock-type to give safety as the boughs sway. A similar safety from the wind is attained by the depth of the cup-nest of the Great Reed-Warbler (*Acrocephalus stentoreus brunescens*), slung amongst the stems of the reedbeds which bend over at an angle of 45 degrees when the wind blows. Though here the situation of the nest is chosen not so much as a protection from enemies as to allow the birds to colonise a habitat for which there is little competition.

Protection from climbing enemies is also attained by the method



The Pendant Nest of the Thick-billed Flower-pecker—*Piprisoma squalidum*.
Nurpur 2,000 ft. C/3 eggs, 15th April, 1921.

of suspending the nest beneath a bough and most effectively from the tip of it. To secure the effect of suspension a considerable modification of structure is necessary and is attained by starting the nest in the form of a pendant loop of material, gradually filled in from the sides. This postulates considerable skill even for species like the common Purple Honeysucker (*Cinnyris asiatica*) which only use ordinary building materials. It does not seem surprising therefore that species which have attained the art of suspending their nests have also special skill in the use of unusual materials. This development reaches its apogee in the wonderful felt nests of the Flower-peckers (*Dicaeum*) and the strong grass-woven nests of the Weavers (*Ploceus*). One can hardly envisage a more wonderful nest than that of the Baya (*Ploceus philippinus*); it is suspended by a cord from the tip of a palm leaf or thorny bough, and the inaccessibility of the site is reinforced by the close weaving of the tough grass strips (torn specially by the bird to suit its requirements), the long pendant entrance tube and the peculiar position of the egg chamber.

The reality of the protection afforded by these modifications of site is shown by their prevalence in tropical countries and their rarity in temperate countries where the enemies that inspire them are scarcer.

Compared with such nests, the far-more famous and advertised nests of the Tailor-birds (*Orthotomus*) and of certain Wren-Warblers (*Prinia* and *Franklinia*) are less wonderful. One or more leaves are linked together with threads and, in the cavity so formed, an ordinary cup-nest is suspended. The so-called 'sewing' of the leaves has attracted popular notice but the constructive skill involved is really far less than in numberless other nests.

This point—appeal to the imaginative faculties of the human mind—must be given its proper value in assessing the comparative development of different types of nest. The use of a given type of material may necessarily lead to a certain type of treatment with the result that a nest is produced which appeals to the human imagination, though it may be far less developed or wonderful in reality than structures which we accept without comment.

A case in point is that of the mud-nest of the Flamingoes (*Phoenicopterus*). This is a very simple structure, a little mound of mud moulded roughly in the shape of a cup-nest and baked by the action of the sun. It is the sort of nest which forms a simple solution of the difficulty of breeding on half-submerged mud-flats where alterations in the water level are apt to occur. Scrape up a heap of mud in such a place and pat it well into shape and firmness and immediately a little island is formed. The solution and the nest are amongst the simplest. Yet such a nest has been unduly advertised first of all because of a prevalent belief at one time that the long legs of the Flamingo could only be accommodated by a high clay cone which the bird straddled as if on a saddle, and secondly because, in 1912, a libel action was fought in the King's Bench Division, connected with Abel Chapman's and Col. Willoughby Verner's writings on the subject.

It is customary to consider the laying of eggs on the open

ground as a primitive arrangement. With this I am quite unable to agree. I started by showing the primitive treatment of the eggs is undoubtedly that of concealment within the ground, whether in a mass of decaying matter like reptiles and megapodes or in crevices and burrows. The nest and egg only emerged into the open with development. And here we must keep in mind two separate lines of development. The nest and eggs of certain of the Willow-Warblers (*Phylloscopus*) are placed on the ground merely as a variant of the tree and bush sites adopted by others of the family. They have undergone no separate modification in connection with their ground building. The eggs and nests agree with those of the non-ground building forms, taking with them the same chances of concealment and discovery. In some species indeed the ground site and the bush or tree site are alternative. In some families such as the Wagtails and Pipits (*Motacillidæ*) the ground feeding habits of the species have made the ground nest almost universal, but neither nests nor eggs show any modifications which necessarily limit them to a site on the ground.

In birds like the Plovers (*Charadriidæ*) on the other hand the ground site is accompanied by the most substantial modifications and developments which cut them off entirely from the first case. Take the case of that familiar Indian bird, Jerdon's Little Ringed Plover (*Charadrius dubius jerdoni*). The three or four eggs are laid on a bed of shingle or sand and so closely resemble the stones around them that they are discovered by the eye—human or avian—with the utmost difficulty. The nest is a natural hollow in the shingle or a scrape in the sand, and if any material at all is used in its construction, the material chosen is small pebbles and pieces of dry clay which further the plan of concealment. It is useless to contend—as is sometimes done—that this is the primitive nest, the scrape in the ground from which all other nests have started. As much development has taken place between the white reptile egg in its hidden site and the Little Ringed Plover's egg on the shingle as between the original starting point and the elaborate structure of the Baya (*Ploceus philippinus*),—other needs, other modifications. Safety has been obtained on the one hand by elaborate construction and difficulty of access, on the other hand by increasing the difficulties of search. The Kentish Plover (*Charadrius alexandrinus*) indeed goes a step further than the Little Ringed Plover in concealment. Its eggs and nesting habits are similar except that it usually nests on sand, and this sand it heaps up over the eggs until they are almost buried from sight.

It is in the eggs and young of these ground-breeding species that the most acceptable examples of protective colouration may be found; and their importance is enhanced by the fact that totally unrelated forms have reached independently the same degree of development. The perfection of the Little Ringed Plover's nesting habits is paralleled by the case of the Sandgrouse (*Pterocletes*) and the Nightjars (*Caprimulgidæ*), totally unrelated forms and it is obvious that all have attained the same result by independent progress on a parallel line as the result of identical needs.

And here I may emphasise once more the fact that development

of nesting habits has no connection with physical evolution. The Nightjars have no connection with the Sandgrouse though both lay eggs, similar in peculiar shape and colouration; while both rely for protection on the blending of the eggs, with the ground on which they are laid without a nest. Whilst amongst the Nightjar's nearest relatives are the Humming birds (*Trochilidae*), which construct ordinary cup-nests of the prevalent type, and the Swifts (*Microptes*) which make most specialised nests. There is no need for me to describe the nesting of the Swifts here, as I have recently in the *Journal* (xxxiv, 772-777) discussed some of their peculiar methods. But I may emphasise that in the Swifts we find a very unusual degree of special development.

In all the types of nest which have been described above, and indeed practically in all nests, the materials used are collected by the birds from extraneous sources. The Swifts have the peculiarity that in the breeding season their salivary glands are enlarged to provide a glutinous substance, hardening with contact of the air, which is used largely in the construction of the nests. In the genus *Collocalia* the nest is made entirely of this saliva.

There is one other way in which birds provide their own nesting material. This is by plucking feathers and down from their own plumage. It is not common and is chiefly confined to the family of the ducks and geese (*Anatidae*) amongst which it is general.

But though we may find down and feathers used in the construction of innumerable nests we will practically always find that the feathers were not provided from its own body by the owner of the nest. They were picked up loose and derelict, part of the World's rubbish like most of the materials of most nests.

There is no need for me to give a catalogue of the types of nest or a description of various very remarkable nests which are to be found in India. Such details may be taken from various books which describe the nesting of Indian birds, or culled from the bird-nesting experience of the reader. My aim has been merely to suggest the lines of evolution to which are probably due the infinite variety of form and fashion. But before closing the chapter I must add a few words on a question that sooner or later occurs to all—how does a bird learn to make its nest?

Now one thing is definitely certain that the architecture of a bird's nest is specific. A Little Ringed Plover breeding in one part of India will build the same nest as another Little Ringed Plover in a different part of India, perhaps a thousand miles away. A common Babbler's nest in the Punjab is exactly the same as a nest of the same species in Salem District. There will be a small limit of variation of course both in materials and construction; there will be the occasional freak nest; while occasionally we notice a species for which two or three types of nest are specific. The Ashy-Wren-Warbler (*Prinia socialis*) for instance may build a circular domed nest in a bush, or it may sew two leaves together and build a cup-nest within the resulting cavity, either type being normal for the species, if not perhaps for the same individual.

But within this reasonable amount of latitude we can lay it down as an established law that all birds' nests remain true to their

specific type. This fact defeats all explanations as to how a bird learns to make its nest. A pair of birds start to breed in their first season. There is no hesitation how to set about the matter; there is no doubt of success, except from other factors; there is no system of trial and error resulting occasionally in the building of a nest proper to some other species. But the young pair immediately set to and build the nest of their species complete in all essentials, with no one teaching them how to do it. So far no one has been able to explain this ability. Various suggestions have been put forward, that the birds remember the nest within which they were born and therefore reproduce the same details; that young birds see the older individuals of their species building and copy their activities; that birds act from an inherited instinct which orders their work without their volition; or that nest-building is as much a psychological response to the physiological aspects of the breeding season as is the act of coition. There are objections to each theory. At present we can no more explain how a bird learns to build its own particular type of nest than say why the Indian Robin (*Saxicoloides fulicata*) invariably finishes off its nest with a piece of Snake's slough.

INDIAN DRAGONFLIES.

BY

F. C. FRASER, LT.-COL., I.M.S., F.E.S.

Part XXXVIII.

(With two plates and a text-figure).

(Continued from page 76 of Volume XXXV).

Sub-family : PLATYSTICTINÆ. (Continued).

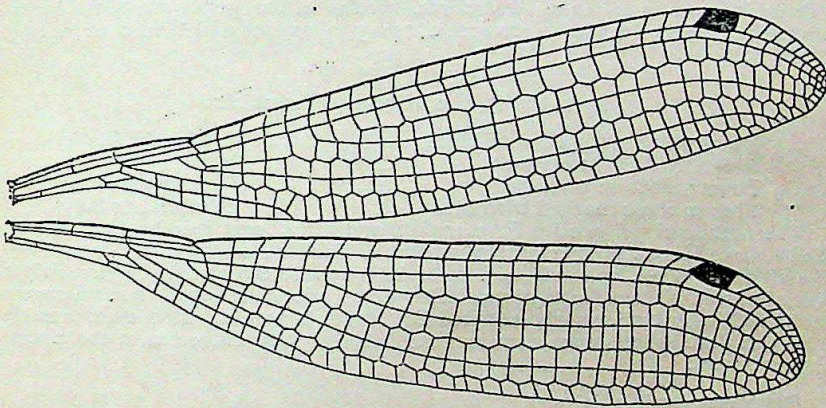


FIG. 1. Wings of *Platysticta deccanensis*, Laid.

Genus : PLATYSTICTA Selys (1860).

Platysticta Selys, Bull. Acad. Belg. (2), x. p. 436 (1860); Id. (Subgenus *Platysticta*, 1st group) Mem. Cour. xxxviii, p. 150 (1886); Id. Syn. Agr. sep. pp. 5, 6, 8 and 9 (1860); Kirby, Cat. Odon. p. 132 (1890); Laid. Rec. Ind. Mus. vol. xiii, pp. 339, 340 (1917); Id. *Spolia Zeylanica*, vol. xii, p. 360 (1924); Fraser, Legion *Platysticta*, Rec. Ind. Mus. vol. xxvi, p. 498 (1924); Laid. Journ. Malay branch, Roy. Asia. Soc. vii. pp. 303-304 (1924).

Dragonflies of slender build with the characteristics of the sub-family, of rather larger stature than the Protostictas but resembling them closely otherwise. Body-colouring non-metallic, black, brown or bright brick-red marked with azure blue. Wings closed when at rest, long narrow, falcate at apex, with a long petiole, hyaline or opaque at apices; discoidal cell elongate, costal border about four times as long as the proximal and slightly longer than the posterior; sectors of arc arising at lower part of arc *but diverging from origin*; an accessory basalpostcostal nervure always present near base of wing in addition to the nervure *Ac* which is situated about midway between the two

antennal nervures; *Ab* always present but incomplete, meeting *Ac* at or well away from the posterior margin of wing and extending to the posterior side of discoidal cell which it meets at a point near its middle; *IA* absent; *Cu* of about 6 to 9 cells in length; *MA* and *IR* zigzagged almost from origins; *Riv+v* arising a short distance proximad to the oblique nervure descending from the subnode, *IR* slightly proximad to the level of the subnode; postostigma subquadrate, costal side shorter than posterior which is somewhat convex, inner border oblique, unbraced, outer straight; cells of wings mainly pentagonal.

Head, thorax and abdomen similar to *Protosticta* but the latter less than double the length of wings; anal appendages variable, superiors forcipate, spatulate at apices; inferiors usually shorter than superiors, broad at base, tapering to the apex which is acute or obtuse, directed straight back or curled inwards towards its fellow. Genitalia,—hamules broad quadrate plates, penis with apex curled strongly over dorsum and its branches long, curled and embracing the stem of organ; a crest or ruff on the dorsum which simulates a spine as viewed in profile; lobe flask-shaped. Vulvar scales very robust, minutely spined below, usually extending beyond end of abdomen. Larvæ unknown. Genotype.—*Platysticta maculata* Selys.

Distribution.—South India and Ceylon only. Three species only are included in this genus from within our limits and it is doubtful if other species outside of this area can be strictly classed as congeneric to *P. maculata*. Two species are from Ceylon, the third from Cochin in South India. The genus as defined here includes only those species which fall within the Selysian subgenus *Platysticta*, group 1. Like *Protosticta*, species of the genus are to be found along the banks of montane streams clinging to mosses and ferns overhanging shady spots.

Key to the species of genus *Platysticta*.

1. { Wings of male tipped with black *P. apicalis* Kirby.
- { Wings hyaline throughout 2.
2. { Thorax uniform brick-red *P. deccanensis* Laid.
- { Thorax black marked with blue *P. maculata* Selys.

The authorship of species *P. maculata* and *C. hilaris* has been shown as Selys, since Hagen's papers published in the Verhandlungen der k.-k. zool.-bot. Gesellschaft Wien, vols. viii and ix of 1858 and 1859 respectively gave only a list of names without descriptions. The descriptions of these two species were published later by Selys who adopted Dr. Hagen's names. It is even possible that the descriptions were communicated to Selys by Hagen as in the case of many others.

Platysticta maculata Selys.

Disparoneura maculata Hagen, Verhandl. zool.-bott.-Gesell. Wien. vol. ix. p. 206 (1959).

Platysticta maculata Selys, Bull. Acad. Belg. (2) x. p. 437 (1860); Id. Rev. Syn. Agr. sep. p. 151 (1886); Kirby. Cat. Odon. p. 132 (1890); Id. Journ. Linn. Soc. (Zool.) xxiv. p. 561 (1893); Laid. Rec. Ind. Mus. vol. xiii, p. 341 (1917); Id. ibid. vol. xi, p. 387 (1915); Id. *Spolia Zeylanica*, vol. xii, p. 361 (1924).

Platysticta greeni Kirby, Proc. Zool. Soc. Lond. p. 204, pl. xx. figs 3, 3a (1891).

Male. Abdomen 47-48 mm. Hindwing 31-33 mm.

Head velvety black; labium brown paling to dirty white at base; labrum glossy black, pale azure blue for its basal half; anteclypeus pale azure blue as also bases of mandibles adjacent to it; postclypeus and rest of head unmarked; eyes black above, dark olivaceous brown below.

Prothorax black, its sides low down palest blue.

Thorax velvety black on dorsum as far lateral as the anterior border of metepimeron and traversed on each side midway between the humeral and postero-lateral sutures by a narrow pale blue oblique stripe. The hinder three-fourths of metepimeron palest blue changing to creamy white beneath thorax. Legs brown, trochanters and coxæ creamy white, the base and flexor surface of femora pale, spines pale golden yellow.

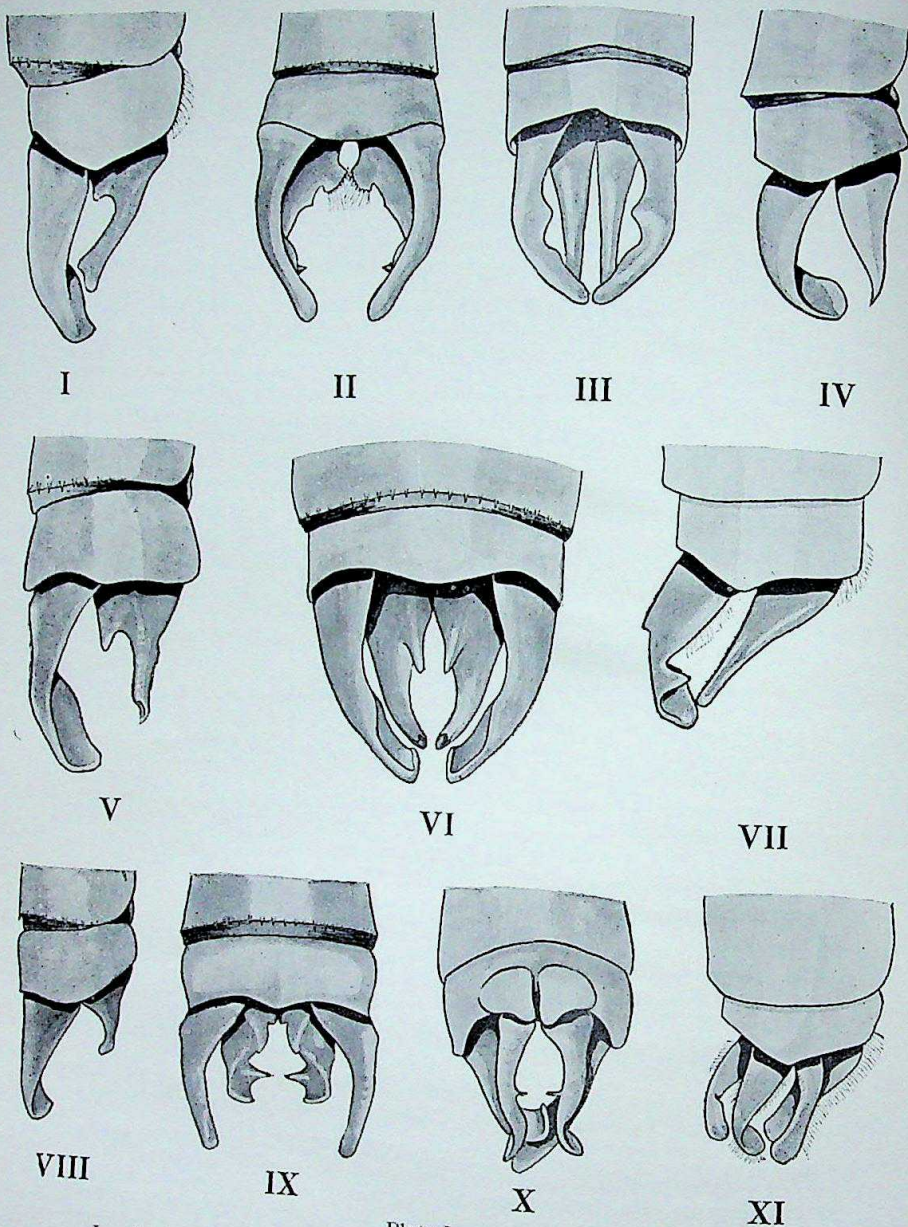


Plate I.

- I. Anal appendages of *Ceylonosticta tropica* (Selys), seen from the right side.
- II. The same, dorsal view.
- III. Anal appendages of *Platysticta deccanensis* Laid., dorsal view.
- IV. The same of *Drepanosticta annandalei* Fras., seen from the right side.
- V. Anal appendages of *Platysticta apicalis* Kirby, seen from the right side.
- VI. The same, dorsal view.
- VII. Anal appendages of *Platysticta deccanensis* Laid., seen from the right side.
- VIII. The same of *Ceylonosticta digna* (Selys), seen from the right side.
- IX. The same, dorsal view.
- X. The same of *Drepanosticta viridis* Fras., ventral view.
- XI. The same of *Ceylonosticta montana* (Selys), right dorsal view.

(Camera lucida drawings, all drawn to the same scale.)

Wings hyaline palely tinted with yellow; pterostigma subquadrate but slightly longer than broad, inner border very oblique, outer slightly convex, costal border four-fifths the length of posterior, dark reddish brown framed finely in yellow and enclosed in thick black nervures; 20-25 postnodal nervures in forewings, 19 in the hind; *ac* and *ab* meeting the posterior border of wing at a common point, *ab* meeting discoidal cell nearer its base than outer end.

Abdomen black above, yellow along the ventral border and below, the sides of segments 1 and 2 and base of 3 pale yellow, this colour forming basal annules interrupted on the dorsum on segments 3 to 7. Segments 8 to 10 azure blue on dorsum, this colour broad at apical end of segment 8 and tapering to a fine point on the middorsum just short of the base of segment; segment 10 black at sides.

Anal appendages black, paler at apices; superiors nearly twice the length of segment 10 which is very short; seen from above these appendages are forcipated curling gently inwards at apices, broad at base then tapered at the middle, again abruptly dilated on the inner side, from which point as far as apex they are of even width and spatulate (The whole appendage viewed from above resembles a Krop razor with its blade nearly fully opened). Inferior appendages rather more than half the length the superiors, very broad at base, tapering rapidly to an obtuse point, the apical fourth angulated inward; a small subbasal tubercle on the inner side.

Female. Abdomen 36 mm. Hindwing 29 mm.

Closely similar to the male save for sexual characters. Prothorax with two curious bosses on the dorsum of middle lobe; segments 8 and 9 blackish brown on dorsum, unmarked with blue; segment 10 with a large spot of blue on the middorsum, its apical border ridged. Vulvar scales robust, extending beyond end of abdomen, minutely spined below; anal appendages short, pointed at apex, conical, as long as segment 10.

Distribution.—Confined to the hilly tracts of Ceylon at elevations of 3,000 to 4,000 ft. Rhabodda, Punduloya, Urugalla during April and May.

In the British Museum collection there are no less than three species included under the head of *P. maculata* but I do not think that there is much doubt as to which of these is the actual species under discussion. The description given here is from specimens collected by Col. F. Wall at Urugalla and compares so closely with the original description that there can be no doubt as to the correct identification of Col. Wall's specimens.

Platysticta apicalis Kirby.

Platysticta apicalis Kirby, Journ. Linn. Soc. (Zool). xxiv. pp. 561, 562 Pl. xlii, fig. 1. (1893); Laid. Rec. Ind. Mus. vol. xiii, p. 341 (1917); Id. Ibid. vol. xi p. 387 (1915); Id. *Spolia zeylanica*. vol. xii. p. 361 (1924).

Male. Abdomen 48 mm. Hindwing 34 mm.

Head velvety black with a steely blue reflex; labium pale brown; labrum, bases of mandibles, ante- and post-clypeus azure blue, rest of head unmarked. Eyes black above, dark brown below.

Prothorax azure blue, posterior lobe black.

Thorax steely black with a blue reflex, marked on each side with a narrow oblique azure blue stripe on the mesepimeron. Beneath and along lower border of metepimeron pale yellow.

Legs black, coxae, trochanters and bases of all femora pale yellow. Wings hyaline with the apices of all blackish brown as far proximad as the inner end of pterostigma which structure is twice as long as broad, inner end oblique, outer end angulated or convex, covering one or two cells, dark blackish brown; 19 postnodal nervures in forewings, 18 in the hind; *ac* very oblique and meeting *ab* very near the posterior margin of wings; other features of venation as for the genus.

Abdomen black on dorsum, yellow low down on the sides and beneath except for the last few segments. Segments 8 to 10 azure blue on dorsum, but the base of the former segment narrowly black which projects into the blue along the middorsal carina as a tapering point.

Anal appendages black; superiors two and a half times as long as segment 10 which is very short, broad at base, then tapered as far as the middle where it again dilates as a compressed spatulate apex somewhat squared at the end.

Seen in profile, the appendage is convex dorsally and rather strongly curved at its middle. Inferiors about four-fifths the length of superiors, very broad at base, then tapered as far as apex which ends in an acute abruptly turned-up point; a very robust spine projecting back from the dorsum near its base.

Female. Abdomen 42 mm. Hindwing 36 mm.

Closely similar to the male except for sexual characters, differing only by its wings which are tipped with yellow instead of blackish brown, and by the terminal abdominal segments the 8th being entirely black, 9 with a small greenish blue or yellow spot on each side and 10 with its dorsum greenish blue or yellow. Anal appendages conical, pointed at apex, as long as segment 10. Vulvar scales robust, extending to end of abdomen.

Distribution.—Ceylon only, confined to the montane tracts. Belihul-Oya during June, and Madulsima where Mr. Bainbrigge Fletcher took a few specimens during August. It is probably on the wing from June to August or September. The species is probably very local and has only been taken in the years 1892 and 1908; it should not be difficult for Ceylon entomologists to rediscover this beautiful insect and give us some account of its habits.

Platysticta deccanensis Laidlaw.

Platysticta deccanensis Laid. Rec. Ind. Mus. vol. xi, p. 388, text-fig-1. (1915); Id. ibid. vol. xiii, pp. 340, 341, Pl. xv. fig. 4. (1917); Fras. Id. vol. xxvi. pp. 498, 499 (1924).

Male. Abdomen 45-47 mm. Hindwing 31-32 mm.

Head.—Labium yellowish; labrum and anteclypeus azure blue, the former narrowly bordered with black; postclypeus azure blue bordered above with black; rest of head matt black; 3rd joint of antennæ brownish at its distal end; eyes black above, olivaceous brown below;

Prothorax dark reddish brown above paling to light red at the side and yellowish beneath.

Thorax bright brick-red changing to golden yellow low down on the sides and pale yellow beneath. Middorsal carina and antealar sinus narrowly marked out in black.

Legs reddish brown, femora at proximal ends and coxæ and trochanters golden yellow.

Wings palely enfumed, hyaline; pterostigma dark red framed finely in light yellow and heavy black nervures, not quite twice as long as broad, inner end pointed, outer border straight, costal border shorter than posterior, covering 1 to 2 cells; *ac* meeting *ab* at the posterior margin of wing or a short stalk intervening, *ab* short and often sinuous; 17 to 21 postnodal nervures to forewings, 17-19 in the hind.

Abdomen dark reddish brown paling to golden yellow beneath at bases of segments 2 to 6; segments 8 to 9 azure blue but segment 8 has a narrow black basal annule and both it and 9 are bordered below with black; segment 10 blackish brown, very narrow.

Anal appendages black, subforcipate as seen from above; superiors broad at base constricted at about the middle where a robust obtuse spine is seen on the inner side, then broadened and somewhat spatulate for the apical half which is curled down and in and hollowed out; inferiors nearly as long as superiors, broad at base then tapered as far as apex which ends in an obtuse point turned slightly inward.

Female. Abdomen 36-40 mm. Hindwing 28-29 mm.

Differs rather widely from the male, far more so than is usual in the subfamily; head similar to male; prothorax coloured similarly, the posterior lobe very broad, rounded.

Thorax brick-red, the middorsal carina and antealar sinus mapped out in black, the dorsum and anterior half of mesepimeron black but the ground colour showing as a fine line against the middorsal carina and upper humeral region, the humeral suture being finely delineated in reddish and the upper and lower part of mesepimeron more broadly so. Traversing the black of dorsum is a narrow antehumeral pale blue stripe convex inwards and not extending to upper part of thorax; bordering the black area of mesepimeron, another similar blue stripe (a beautiful ensemble of colours); beneath as for male.

Legs and abdomen similar to male but segment 1 bright brick-red at the sides, segment 8 unmarked with blue, segment 9 with a large oval pale blue

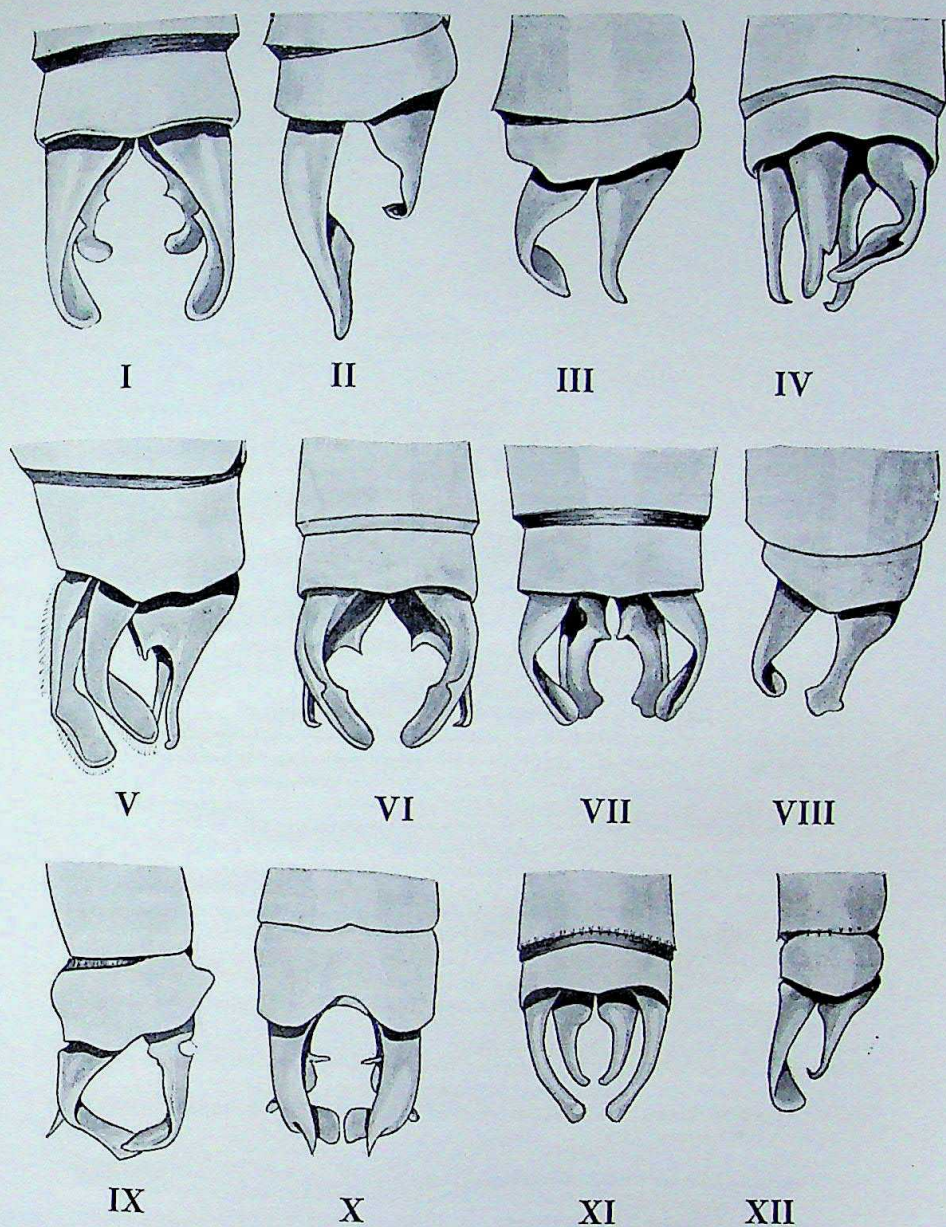


Plate II.

- I. Anal appendages of *Platysticta maculata* Selys, dorsal view.
- II. The same, seen from the right side.
- III. Anal appendages of *Drepanosticta carmichaeli* Laid., seen from the right side.
- IV. The same, dorso-lateral view.
- V. Anal appendages of *Ceylonosticta hilaris* (Selys.), seen from the right side.
- VI. The same, dorsal view.
- VII. Anal appendages of *Ceylonosticta nietneri* sp. nov., dorsal view.
- VIII. The same, seen from the right side.
- IX. Anal appendages of *Drepanosticta viridis* (Fras), dorsal view.
- X. The same, seen from the right side.
- XI. *Ceylonosticta lankanensis* sp. nov., anal appendages dorsal view.
- XII. The same, seen from the right side.

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Camera lucida studies, all drawn to the same scale.

lateral spot. Segments 7 to 10 are blacker than in the male, segment 8 only about one-fourth the length of seven, segment 9 nearly twice the length of 8, and segment 10 very short as in the male.

Anal appendages short, not longer than segment 10, reddish brown, pointed, conical. Vulvar scale very long and robust, extending well beyond end of abdomen and with a robust spine above the end.

Wings usually more deeply enfumed than in the male, pterostigma of similar shape but more blackish than reddish brown; 20 postnodal nervures in forewings, 17 in the hind.

Distribution.—Confined so far as known to Cochin, South India. The type is in the Indian Museum and was taken at Kavalai, Cochin State on 24-27. ix. 14. Wishing to obtain more of these interesting and beautiful insects and to study their habits, I revisited Kavalai in September, 1928, and took 17 males and 4 females at the same stream as the types came from. Most were found resting on maidenhair fern in dark shady spots, a number being seen in a culvert running beneath the forest railway. The red thorax and the blue identification marks, especially the latter, were very conspicuous. The flight of the insect is short and weak. Although very local, it was by no means uncommon and I suspect this to be the case with *P. apicalis* its near relation. The colouring of the female with its blue striped thorax is nothing less than remarkable and without parallel in an order where, if the female differs from the male, it is usually on the side of duller and less conspicuous colouring. It would suggest a more primitive insect in which both sexes were black with blue antehumeral and lateral stripes as is the case with *Indoneuras*, the male having subsequently lost these markings in favour of heliochromatic tints.

CEYLONOSTICTA gen. nov.

Platysticta 2me groupe Selys, Syn. Agr. Derniere Legion, sep. p. 9 (1860).

Dragonflies of smaller size than the last genus but with similar habits and characters. Body-colouring black and brown with blue markings. Wings closed when at rest, long, narrow, falcate at apex, with a long petiole, hyaline, never opaque; discoidal cell shaped as in *Platysticta*; sectors of arc arising from lower part of arc but fused for a short distance from origin; an accessory basal postcostal nervure present near the base of wings in addition to the nervure *Ac* which is situated rather nearer the distal antenodal nervure; *Ab* always present but incomplete, meeting *Ac* at or a little away from the posterior margin of wing and extending to the posterior side of the discoidal cell which it meets at a point near its proximal end; *IA* absent; *Cvii* of about 6 to 8 cells in length; *MA* and *IRiii* not zigzagged at origins; *Riv + v* arising a short distance proximad to, at or slightly distad of the oblique nervure descending from the subnode, *IRiii* at or slightly distad the level of subnode; pterostigma similar to genus *Platysticta*; cells of wings mainly quadrangular.

Head, thorax and abdomen similar to *Protosticta* but the latter less than double the length of wings; anal appendages variable, superiors usually somewhat forcipate and spatulate at apices; inferiors tapering from base to apex or more widely variable in the species. Genitalia of both sexes very similar to genus *Platysticta*.

Larvæ unknown. Genotype.—*Ceylonosticta hilaris* (Selys).

Distribution.—Confined to Ceylon in montane and submontane tracts. Habits similar to those of *Platysticta* so far as known. The original descriptions are poor so that without the actual types before one, it has been difficult or impossible to accurately determine the available material. Four species were originally described by Selys but a fifth has been described since by Dr. Laidlaw under the heading of *Drepanosticta* sp. which he surmises however, and I think with good reason, may be conspecific with *P. hilaris* Selys. Another pair, also described as *Drepanosticta* sp., but presumably differing from the above, was said by the same author, to be too damaged to identify. I have also found some difficulty in determining some material before me, collected by Col. F. Wall, I.M.S., several species of which do not compare exactly with the Selysian descriptions. Thus it is certain that more species remain to be described and three of such have been named below. Further material is greatly to be desired and it is hoped that Ceylon entomologists will assist us in elucidating this problem.

Key to species of genus *Ceylonosticta*.

- | | | | |
|---|---|--|--------------------------------|
| 1. | { | Moderately large species with abdomen more than 40 mm. in length | 2 |
| Smaller species with abdomen less than 40 mm. in length | | 4 | |
| 2. | { | Anterior lobe of prothorax prolonged forward as two stalked process | <i>C. tropica</i> (Selys.) |
| Anterior lobe of prothorax simple | | 3 | |
| 3. | { | Inferior anal appendages acutely pointed; labrum bordered with black | <i>C. hilaris</i> (Selys.) |
| Inferior anal appendages obtuse at apex; labrum not bordered with black | | <i>C. montana</i> .. | |
| 4. | { | Inferior anal appendages viewed dorsally squared at apex and with a very robust subapical spine directed inwards to meet its fellow across the middle line | <i>C. digna</i> .. |
| Inferior anal appendages simple, without subapical spine | | 5 | |
| 5. | { | Very small species with abdomen less than 30 mm. in length; labrum finely bordered with black; inferior anal appendages acuminate at apex; posterior lobe of prothorax simple | <i>C. lankanensis</i> sp. nov. |
| Very small species with abdomen less than 30 mm. in length; labrum broadly bordered with black; posterior lobe of prothorax prolonged into a long tapering point | | <i>C. walli</i> sp. nov. | |
| Larger species with abdomen more than 30 mm in length; inferior anal appendages trilobate at apex | | <i>C. nietneri</i> .. | |

Ceylonosticta hilaris (Selys).

Agrion hilare Hagen, Verhand. zool-bot-Gesell. Wien, vol. viii, p. 479 (1858). Name only given.

Disparoneura hilaris Id. ibid. vol. ix, p. 206 (1859). Name only given.

Platysticta hilaris Selys, Bull. Acad. Belg. (2) x. p. 438 (1860); Id. Syn. Agr. sep. pp. 11 and 12 (1860); Id. Rev. Syn. Agr. sep. p. 151 (1886); Id. Mem. Cour. xxxviii, p. 152 (1886); Kirby, Cat. Odon. p. 132 (1890); Id. Journ. Linn. Soc. Zool. vol. xxiv, p. 562 (1893); Laid. Rec. Ind. Mus. vol. xi, p. 387 (1915).

Drepanosticta hilaris Laid. *Spolia Zeylanica*, Vol. xii, pp. 362, 364 (1924).

Drepanosticta sp. Laid. 1. c. Vol. xii, pp. 362-364 (1924).

Male. Abdomen 42 mm. Hindwing 25 mm.

Head.—Labium brown; labrum pale turquoise blue narrowly bordered with glossy black; bases of mandibles glossy black, the extreme base only blue; anteclypeus turquoise blue; postclypeus glossy black, rest of head bronzed black with a large patch of obscure reddish brown partially encircling the ocelli behind and on each side; eyes black above, olivaceous brown beneath; occiput with a projecting scale like ledge pointed at either end overlapping anterior lobe of prothorax.

Prothorax bronzed brown on dorsum, paler brown laterally; anterior lobe sloping forward encircling the neck like a stiff collar; middle lobe with a deep central pit situated between two prominent rounded bosses; posterior lobe simple rounded, the posterior border straight or very shallowly concave.

Thorax bronzed black or deep coppery brown on dorsum changing to reddish brown and then ochreous on the sides and beneath. A narrow oblique azure blue stripe on each side traversing the centre of mesepimeron, after which is a thin black line on the postero-lateral suture. (In the original description the blue stripe is omitted probably because decomposition had obscured it.)

Wings hyaline, enfumed and tinted palely with yellow; pterostigma reddish brown finely framed in yellow and thick brown nervures, rather longer than broad, inner side a little oblique, outer nearly straight; 15-16 postnodal nervures in forewings, 14-15 in the hind; R_{2+3} arising slightly distad or in

continuation of the oblique nervure descending from the subnode; *ab* meeting near the hinder border of wings.

Legs yellow or olivaceous, outer surfaces of femora and articulations blackish.

Abdomen dark reddish brown deepening to bronzed black at ends of segments; sides of segments 1 and 2 paler; segments 3 to 7 with moderately broad basal annules; segment 8 with its apical border broadly and the whole of segments 9 and 10 azure blue, reddish brown below and along ventral borders.

Anal appendages blackish brown; superiors more than twice the length of segment 10, broad at base then tapering and curving down in the apical half which is broadened out, excavated on its inner side and squared at the apex. A small dorsal spine situated at the point where the appendage begins to broaden out. Inferior appendage slightly shorter than superiors, very broad at base where is situated a robust dorsal spine, then slender and tapering to an acute point at apex.

Female. Abdomen 36-37 mm. Hindwing 26-27 mm.

Closely similar to the male in colouring and markings,—differs as follows:—border of labrum less broadly bordered with black and the black border itself bordered with reddish brown; legs yellow, articulations only blackish. Wings more deeply enfumed; 15-17 post-nodal nervures to forewings, 14-15 in the hind; *Riv+v* arising proximal to the oblique nervure descending from the subnode. Abdomen similar but the basal annules pale blue in old specimens, yellow in others and tenerals; segment 8 unmarked with blue, 9 with only a small subdorsal oval spot near the apical border of each side of segment, 10 with a large dorsal spot.

Anal appendages reddish brown, conical, pointed at apex, barely as long as segment 10; vulvar scale robust, extending well beyond end of abdomen.

Distribution.—Ceylon only. Rhambodda Ghat, Kandy and other montane areas from May to September. The figure given of the anal appendages by Dr. Laidlaw for his *Drepanosticta* sp., is sufficient proof that this species is *C. hilaris* as he surmised. Post-mortem decomposition accounts for the differences to be noted between the above and the Selysian description. From *C. digna*, this species is easily distinguished by the shape of its inferior appendages; from *C. tropica* by the simple collar-like anterior lobe of prothorax; from *C. montana* by the labrum bordered with black and by the inferior appendages ending in an acute point; from the remaining species by its much larger size and more numerous postnodal nervures.

Ceylonosticta montana (Selys.)

Platysticta montana Selys, Bull. Acad. Belg. (2) x. p. 438 (1860); Id. Syn. Agr. sep. pp. 10-11 (1860); Id. Mem. Cour. Rev. Syn. Agr. p. 151 (1886); Kirby. Cat. Odon. p. 132 (1890); Id. Journ. Linn. Soc. Zool. vol. xxiv, p. 363 (1893); Laid. Rec. Ind. Mus. vol. xi, p. 387 (1915).

Drepanosticta montana Laid. *Spolia zeylanica*. vol. xii, p. 362 (1924).

Male. Abdomen 43 mm. Hindwing 28 mm.

Head—Labium dark brown; labrum turquoise blue narrowly bordered with reddish brown; bases of mandibles and anteclypeus turquoise blue; postclypeus glossy black, rest of head bronzed black with a broad patch of reddish brown encircling the ocelli on either side and behind; eyes black above, olivaceous brown beneath.

Prothorax bronzed brown on dorsum, paler reddish brown laterally; anterior lobe collar-like; posterior lobe simple, rounded.

Thorax bronzed black on dorsum changing to reddish brown on the sides and yellowish beneath. (Probably an oblique blue stripe on the middle of mesepimeron but obscured by decomposition in the type.)

Legs yellowish, the outer surface of femora and articulations blackish.

Wings hyaline, palely enfumed; pterostigma slightly longer than broad, similar in shape to that of *C. hilaris*; 16-18 postnodal nervures in forewings, 15-16 in the hind; *Riv+v* arising a little distad of the oblique nervure descending from the subnode.

Abdomen bronzed brown on dorsum deepening to black at the distal ends of segments; segments 3 to 7 with moderately broad basal annules; segment

8 unmarked (so far as can be seen in the type, but probably its apical border bluish during life); segments 9 and 10 azure blue on the dorsum. (In the type, segment 9 brown from decomposition.)

Anal appendages blackish brown, superiors more than twice the length of segment 10, broad at base then tapered as far as the middle, at which point they are dilated internally and curved rather strongly downward and furnished with a small obtuse spine at the point of the angulation on the upper inner border of appendages; the dilated part of even width, excavate on the inner side and ending in a squared apex directed somewhat inward and downward. Inferiors slightly shorter than superiors, broad at base, then tapered and slim as far as apex which is again broadened and curved inward towards its fellow; a robust tooth on the upper inner border near the base.

Female. Abdomen 37 mm. Hindwing 26 mm.

Closely similar to the male, differing only in sexual characters and by the markings on the terminal segments of abdomen. A small subdorsal subapical spot of blue on each side of segment 9, and a broad dorsal spot of the same colour on segment 10. Anal appendages as long as segment 10 which is very short and without an apical notch, conical, pointed at apex, brown. Vulvar scale very robust, extending well beyond end of abdomen.

Distribution.—Ceylon only, in montane tracts, Rhabodda Ghat and Kandy. Differs from *C. tropica* by the simple shape of the lobes of prothorax; from *C. hilaris*, to which it is very closely related, by the tumid end of inferior appendages and by the labrum unbordered with black; from *C. digna* by the absence of a middle inner spine on inferior appendages. From the remaining species by its much larger size.

Ceylonosticta tropica (Selys.)

Platysticta tropica Selys. Bull. Acad. Belg. (2). x. p. 438 (1860); Id. Syn. Agr. sep. p. 10 (1860); Id. Mem. Cour. Rev. Syn. Agr. p. 151 (1886); Kirby, Cat. Odon. p. 132 (1890); Id. Journ. Linn. Soc. Zool. vol. xxiv. p. 562 (1898); Laid. Rec. Ind. Mus. vol. xi. p. 387 (1915); Id. Ibid. vol. xiii. p. 341 (1917).

Drepanosticta tropica Laid. Spolia Zeylanica. vol. xii. p. 362 (1914).

Male Abdomen 41 mm. Hindwing 26 mm.

Head—Labium pale brown; labrum, bases of mandibles and anteclypeus pale turquoise blue, the former narrowly bordered with brown; postclypeus bronzed brown above, rest of head bronzed black with a small obscure yellow oval spot on the outer side of each outer ocellus; eyes black above, olivaceous brown beneath; 2nd and 3rd segments of antennæ pale yellowish.

Prothorax pale olivaceous brown, the middle lobe possibly bluish during life; posterior lobe bronzed black, arched, rounded; anterior lobe with a deep and wide cleft at its middle, the lobe on each side of this prolonged into a curious stalked scale resembling those seen on the posterior lobe of some of the *Caconeura* group; between these two scales the lobe prolonged forward as a short blunt process.

Thorax dark bronzed brown or cupreous black on dorsum, the lower part of sides paling to reddish brown and then yellow beneath thorax; a moderately broad oblique azure blue stripe on each side traversing the centre of mesepimeron from above down.

Legs olivaceous, the external and extensor surfaces of femora and the articulations mottled with black.

Wings hyaline palely enfumed; pterostigma blackish brown finely framed in creamy white and again by thick black nervures, half as long again as broad, costal border shorter than posterior, distal border straight, proximal very oblique, braced; *R*₄₊₅ arising slightly before the oblique nervure descending from the subnode; 16-17 postnodal nervures to forewings, 14-16 in the hind; *ab* meeting *ac* at a short distance from posterior margin of wing.

Abdomen bronzed brown deepening to black at apical ends of segments and with narrow basal annules on segments 3 to 7; segment 1 yellow laterally; segments 2 to 4 yellow along the ventral borders; segments 9 and 10 azure blue on the dorsum, the latter narrowly black at the apex.

Anal appendages blackish brown; superiors more than twice as long as segment 10; seen from above curving gently inward towards one another; broad at base then tapered to apex which is obtuse, the apical half presenting

a spatulate-like dilation on the inner border which is hollowed out on its inner aspect. Inferior appendages rather more than half as long as superiors, very broad at base where is seen an inner tubercle which, viewed from above, is broad and coated with numerous stiff bristles. The apical three-fourths slim, sloping up and back and ending in an obtuse shallowly-notched apex as viewed in profile, or as an acutely-pointed, inwardly directed spine as viewed from above.

Female. Abdomen 40 mm. Hindwing 29 mm.

Closely similar to the male in colour and markings but rather more robustly built. Labium dark brown; labrum entirely blue; prothorax with similar scale-like processes on anterior lobe; wings more deeply enfumed; 16 to 17 postnodal nervures to forewings, 16 in the hind; other details of venation similar to the male. No trace of blue to be seen on the terminal abdominal segments but these may be obscured by post-mortem decomposition, and during life are probably present as subdorsal spot on the sides of segment 9 and a large dorsal spot on segment 10. Anal appendages short, barely as long as segment 10, conical pointed, brown; segment 9 about one-third longer than 8 and more than twice the length of 10. Vulvar scales moderately robust, blackish brown, *not extending to end of abdomen*.

Distribution.—Confined to the montane tracts of Ceylon. Passara, Haycock Hill, May to August. Hakgala, March and April. The description of the female which has not hitherto been published, is from a specimen in the author's collection from Hakgala.

There is no possibility of confusing this species with any other as the curious prothoracic processes are unique in the genus and are sufficient to determine the species at a glance. It is of interest to note that these accessory sexual appendages are found in both sexes.

Ceylonosticta digna (Selys.)

Agrion digna Hagen, Verhandl. Zool.-bot. Gesell. Wien, vol. viii. p. 479. (1858).

Disparoneura digna, Hagen, Ibid. vol. ix. p. 207 (1859). Name only.

Platysticta digna, Selys, Bull. Acad. Belg. (2) vol. x. p. 440 (1860); Id. Syn. Agr. sep. p. 12 (1860); Id. Mem. Cour. Rev. Syn. Agr. xxxviii. p. 151 (1886); Kirby. Cat. Odon. p. 132 (1890); Id. Journ. Linn. Soc. Zool. vol. xxiv. p. 362 (1893); Laid. Rec. Ind. Mus. vol. xi. p. 387 (1915).

Drepanosticta digna, Laid. Spolia Zeylanica, vol. xii. pp. 361, 362, text-figure 9 (1924).

Male. Abdomen 35 mm. Hindwing 23 mm.

Head.—Labium pale brown; labrum, bases of mandibles and anteclypeus pale turquoise blue; postclypeus glossy black, rest of head blackish brown; eyes black above, olivaceous brown beneath; 3rd joint of antennæ palest brown. Occiput with the usual scale-like ledge posteriorly.

Prothorax ochreous, possibly blue on the dorsum during life; anterior lobe arched, sloping forward, collar-like; posterior lobe simple, rounded, dark bronzed brown.

Thorax dark bronzed brown on dorsum paling to reddish brown laterally and yellowish beneath; middorsal carina finely blue and an oblique stripe of the same colour traversing the length of mesepimeron midway between the two lateral sutures.

Legs ochreous, outer surface of femora and all articulations blackish brown.

Wings hyaline palely enfumed in adults; pterostigma blackish brown finely framed in yellow and an outer frame of thick black nervures shaped similarly to that of *C. hilaris*; 15–16 postnodal nervures to forewings, 14 in the hind; *Riv+u* arising in prolongation of the oblique nervure descending from the subnode; *ac* and *ab* meeting at a common point on the posterior margin of wing or a short stalk intervening at the junction.

Abdomen blackish brown, segments 2 and 3 at the sides and the bases of 2 to 7 with basal annules yellow; segment 8 black; segments 9 and 10 azure blue above, black along the ventral borders.

Anal appendages blackish brown; superiors more than twice the length of segment 10, broad at base, then tapering somewhat to apex which is obtuse, slightly curved in and down as viewed from above, and the apical half which is

a little expanded on the inner side, markedly excavate. Inferior appendages about two-thirds the length of superiors, of unusual and irregular shape, very broad at base, outer border sinuous as seen from above, inner border deeply serrate, presenting an obtuse basal tubercle followed by a subbasal which is followed successively by a deep notch, a median robust spine and then a final shallow notch; the median spine is directed straight inwards and nearly meets its fellow on the opposite side; the apex squared and slightly bevelled. Seen from the side the appendage tapers rapidly to an obtuse point. Female unknown.

Distribution.—Ceylon only in montane tracts. Rhambodda Ghat and Haragama from May to August. The above revised description was made from a specimen in the British Museum. The species is easily determined from all others by the curiously shaped inferior appendages. Type in the Selysian collection.

Ceylonosticta nletneri sp. nov.

Male. Abdomen 31–32 mm. Hindwing 20–21 mm.

Head.—Labium pale brown; labrum, bases of mandibles and anteclypeus pale turquoise blue; postclypeus glossy black, rest of head bronzed black; 3rd joint of antennæ pale brown; eyes black above, olivaceous brown beneath; occiput with a similar scale as seen in *C. hilaris*.

Prothorax pale ochreous; posterior lobe except its hinder border and the whole of the dorsum of middle lobe pale blue; anterior lobe collar-like, posterior rounded, simple.

Thorax bright reddish ochreous with a cupreous reflex on dorsum and a broad oblique pale blue stripe on each side situated between the two lateral sutures; pale ochreous beneath.

Legs pale olivaceous, the articulations speckled with black.

Wings hyaline, very palely enfumed; pterostigma blackish brown finely framed in creamy white and thick black nervures, nearly square, but slightly longer than broad, distal side convex, proximal oblique, braced; 14–16 post-nodal nervures in forewings, 13–14 in the hind; *ab* meeting *ac* at a short distance from the posterior margin of wing, the former ending very near the proximal end of discoidal cell; origin of *Riv* + *v* at or slightly distad of the oblique nervure descending from the subnode.

Abdomen yellow beneath and on the sides of segment 1, dark enfumed olivaceous on dorsum and sides, deepening to black at apical ends of segments, and on the whole of segment 7 and most of 8; bases of segments 3 to 4 or 5 with incomplete basal annule which extend apicad along the ventral borders of segments; segment 8 blackish brown marked dorsally with an apical triangle of azure blue which extends variably towards base of segment covering from one-fourth to half the segment; segments 9 and 10 entirely blue on dorsum, the ventral borders black.

Anal appendages blackish brown, apices of inferiors paler brown; superiors twice the length of segment 10, simple, arched up and then down, broad and depressed at base, then, at the middle, twisted on the long axis of appendage, the outer half broadened compressed and hollowed out within, *not bearing any spines*; inferior appendages of the same length, broad at base, directed straight back or a little obliquely upward, of even thickness throughout as far as apex which is expanded into three angles like the webbed foot of a duck; *without a basal spine*.

Female. Abdomen 30–31 mm. Hindwing 22 mm.

Closely similar to the male but of stouter build, the abdomen more especially robust. Differs as follows.—Prothorax more prominently marked with blue on middle and posterior lobes, the latter very simple rounded, the scale-like border very narrow and of even width.

Wings with 14 postnodal nervures to forewings, 13 in the hind, otherwise exactly similar to those of male, but *Riv* + *v* always arising distad the oblique nervure descending from the subnode.

Abdomen dark reddish brown, segments 3 to 7 with broad basal azure blue annules interrupted on the middorsum on the latter segment; segment 8 dark reddish brown, the apical articulation only blue; segments 9 and 10 broadly azure blue on dorsum, reddish brown on lower part of sides.

Anal appendages shorter than segment 10, small pointed conical processes, brown. Vulvar scale brown, robust, extending beyond end of abdomen.

Distribution.—Ceylon only, Kandy, 2,000 ft. Three males and a single female taken at the latter place by Col. F. Wall, I.M.S., 14. x. 24.

This species and the two following—*C. lankanensis* and *C. walli* are the three smallest species known in the subfamily, not excepting *P. hearseyi* and may be distinguished from all other species at a glance by reason of this feature. The curious shape of the apex of the inferior anal appendages, shaped like a duck's foot, will serve to distinguish it from the other two species mentioned of the same size as itself. The female is to be distinguished by the arched rounded shape of its prothorax, this being produced and strongly angulated in *C. walli*, whilst the female of *lankanensis* is unknown.

Ceylonosticta lankanensis sp. nov.

Platysticta montana Kirby, Journ. Linn. Soc. Zool. vol. xxiv. p. 562 (1893).

Male. Abdomen 29 mm. Hindwing 20 mm.

Head.—Labium whitish brown: labrum, bases of mandibles and anteclypeus pale turquoise blue, the former very narrowly bordered with black, rest of head blackish brown; eyes dark brown above, olivaceous brown beneath.

Thorax dark reddish ochreous on dorsum and sides but paling to ochreous on metepimeron and yellowish beneath. A broad oblique pale blue stripe on each side lying parallel with and midway between the lateral sutures, contrasting strikingly with the adjacent reddish brown.

Legs olivaceous marked with dark brown on the outer sides of femora and all articulations.

Wings hyaline, palely enfumed; pterostigma blackish brown, finely framed in white and thick black nervures, similar in shape to that of *C. nietneri*; 12-13 postnodal nervures in forewings, 11 to 12 in the hind; *Riv.* + *v* arising in continuation with the oblique nervure descending from the subnode; *ab* meeting *ac* near the posterior margin of wings.

Abdomen reddish brown deepening to black at apical ends of segments; segment 1 yellow laterally; segments 3 to 7 with narrow basal yellow annules; segment 8 with a small apical triangular bordering of blue; segments 9 and 10 azure blue dorsally, black along the ventral borders.

Anal appendages blackish brown, superiors more than twice the length of segment 10, broad at base then tapering as far as the middle, at which point they are dilated, compressed and rotated on their long axis, the apex broad and squared; seen from above these appendages are curved gently towards one another, of almost even breadth throughout and slightly clubbed at apex; inferiors of about two-thirds the length of superiors, very broad at base, then abruptly slim and cylindrical, curved gently in, the extreme apices more abruptly so and ending in a fine point.

Female unknown. Type in the British Museum.

Distribution.—Ceylon only, confined probably to montane districts. The type is labelled—'Kottawa, 19. iv. 92,' and is incorrectly determined by the late Mr. Kirby as *P. montana*. This specimen is undoubtedly Col. Yerbury's referred to by Kirby as *P. montana* 'with some doubt' in the J.L.S.I.C. Its small size, the smallest species of the genus, is sufficient to determine it from *P. montana* and several other differential points may be made out with ease. The acutely pointed inferior appendages are sufficient to determine it from *C. nietneri* which has them broad and clubbed at the apices and as long as the superiors. It is possible that the next species described below, is the female of this but the curious shape of the hinder margin of the prothorax in the latter and the extensive black bordering of the labrum appear to place it as an entirely distinct species.

Ceylonosticta walli sp. nov.

Female. Abdomen 31 mm. Hindwing 22 mm. (Male unknown.)

Head.—Labium blackish brown; labrum pale turquoise blue broadly bordered with glossy black; bases of mandibles black with a spot of blue at the extreme base; anteclypeus pale turquoise blue, postclypeus and rest of head black bronzed; eyes black above, olivaceous brown beneath: distal end of 3rd segment of antennae pale brown.

Prothorax with middle lobe pale blue, anterior and posterior lobes reddish

brown, the former collar-shaped, the latter with the medial portion of its thinned-out border prolonged into a long tapering point.

Thorax reddish ochreous deepening to dark bronzed brown on dorsum, paling on lower part of metepimeron and beneath; a moderately broad azure blue stripe traversing the whole length of mesepimeron midway between the lateral sutures.

Legs olivaceous, articulations blackish, outer surfaces of femora and whole of tibiae enfumed brown.

Wings hyaline, palely enfumed; pterostigma nearly quadrate especially in the forewings, inner end slightly oblique, outer slightly convex, dark reddish brown framed finely in white and thick black nervures; 15 postnodal nervures in forewings, 14 in the hind; *Riv + v* opposite or a little distad of the oblique nervure descending from the subnode; *ac* and *ab* arising from different points on the posterior border of wings (in the type the nervure *ab* is absent in the right pair of wings).

Abdomen reddish brown changing to blackish brown at distal ends of segments; segments 2 to 7 with azure blue basal annules, very narrow on segment 2, broad on 4 to 6; segment 8 unmarked; segments 9 and 10 with the dorsum azure blue, the ventral borders dark blackish brown.

Anal appendages reddish brown, slightly longer than segment 10, conical, acute at apex; vulvar scale robust, extending beyond end of abdomen.

Distribution.—Ceylon only, confined to montane tracts. Type, a female, in the author's collection, taken at Kandy, 2,000 ft., 13. ix, 24 by Col. F. Wall, I.M.S. Differs from the female of *C. neitneri* by the posterior lobe of prothorax which is prolonged into a long tongue-like point and also by the labrum broadly bordered with black, by the higher nodal index, etc. From the male of *C. lankauensis* it also differs by the shape of the posterior lobe of prothorax, by the labrum broadly bordered with black, by the broader basal blue annules of the abdomen and by the different origin of *ab*, etc.

Genus: DREPANOSTICTA Laidlaw (1917).

Platysticta Selys. *pars.* Bull. Acad. Belg. (2) x. p. 436 (1860); Id. Mem. Cour. xxxviii, p. 150 (1886); Kirby, Cat. Odon. p. 132 (1890); Laid. Rec. Ind. Mus. Vol. xi, pp. 378, 379 (1915).

Drepanosticta Laid. *ibid.* vol. xiii, pp. 339, 341 (1917); Id. Journ. Malay branch Roy. Asia. Soc. vol. ii. pp. 304-306 (1924).

Dragonflies of the same small size as the last genus and with similar habits and characteristics. Body-colouring usually black, but in one species at least, reddish brown marked with blue. Wings closed when at rest, long, narrow, falcate at apex, with a long petiole, hyaline; discoidal cell shaped as in *Platysticta*; sectors of arc arising from lower part of arc but fused for a short distance from origin; an accessory basal postcostal nervure present near base of all wings in addition to the nervure *ac*, which is situated rather nearer distal antenodal nervure, *ab* usually present but sometimes absent and, when present, always incomplete, meeting *ac* at or near the hinder margin of wing or arising from that margin at some point more or less distad of *ac* and extending to the posterior border of discoidal cell near its proximal end; *1A* absent; *Cu* of variable length, usually 6 to 8 cells in length; *MA* and *IR* not zigzagged at origins; *Riv + v* arising slightly before, at or slightly distad of the oblique nervure descending from the subnode; *IR* at or a little distad of that nervure; pterostigma subquadrate, costal side slightly shorter than the posterior, inner end oblique, unbraced, outer slightly convex. Cells of wings mainly quadrangular.

Head, thorax and abdomen similar to *Protosticta* but the abdomen less than twice the length of wings except in *D. viridis*; anal appendages variable, superiors subforcipate, spatulate in the apical half which is curved down and usually carries a robust dorsal spine at the middle; inferiors variable, with or without a long inner narrow spine; genitalia similar to that of *Protosticta*, penis without a dorsal ruff or spine. Larvæ unknown. Genotype.—*Drepanosticta carmichaeli* (Laid.)

Distribution.—N. E. India, Burma, Indo-China, Malaya to New Guinea. The habits of species of the genus are unknown save for *D. carmichaeli* which resemble those of *Protosticta*. Dark shaded retreats are the localities in which to seek these insects, where clinging to ferns, etc. they may be beaten up and

driven into the open. Four or five species are known from within Indian limits, one of which is from Bengal, two or possibly three from Burma and a fifth from the Andamans.

Key to species of genus *Drepanosticta*.

- | | | | |
|---|---|--|-----------------------------------|
| 1 | { | Length of abdomen twice that of hindwing ... | <i>D. viridis</i> Fras. |
| | { | Length of abdomen considerably less than twice that of hindwing ... | 2. |
| | { | Species coloured black marked with white and pale blue ... | 3. |
| 2 | { | Species coloured reddish brown marked with blue ... | 4. |
| | { | Pterostigma slightly longer than broad; thorax with ill-defined blue stripes, blackish brown beneath ... | <i>D. carmichaeli</i> Laid. |
| 3 | { | Pterostigma squared; thorax with well-defined blue stripes, beneath pale yellow... | <i>D. polychromatica</i> sp. nov. |
| 4 | { | Anal appendages complex, furnished with spines ... | <i>D. quadrata</i> Selys. |
| | { | Anal appendages simple, without any spines ... | <i>D. annandalei</i> Fras. |

Drepanosticta carmichaeli Laid.

Prosticta carmichaeli Laid. Rec. Ind. Mus. vol. xi, p. 390, fig. 1 (1915).

Drepanosticta carmichaeli Laid. *ibid.* vol. xiii. pp. 341, 342, pl. xv. fig. 5 (1917); *Id.* Journ. Malay branch Roy. Asia. Soc. vol. ii, pp. 304-306 (1924).

Male. Abdomen 36-37 mm. Hindwing 23-24 mm.

Head.—Labrum brown; labrum turquoise blue narrowly bordered with dark brown; genae, bases of mandibles and anteclypeus turquoise blue; postclypeus, frons and vertex as far back as the level of posterior ocelli blackish brown, behind which an irregular broad band of pale blue extending from eye to eye; occiput behind black, presenting a vestigial ridge behind as seen in *Platysticta*; 2nd joint of antennae pale blue; eyes blue above, paler below and marked with a dark equatorial band of grey.

Prothorax with anterior lobe projecting forward collar like; posterior lobe simple rounded; middorsum olivaceous, the rounded bosses on each side of middle lobe azure blue; posterior lobe reddish ochreous, blue at either side; middle lobe dark chocolate brown on each side and beneath.

Thorax olivaceous on dorsum changing to golden brown laterally and then dark chocolate brown ventrad and beneath. An ill-defined pale blue antehumeral stripe on each side of dorsum confluent with the blue on posterior lobe of prothorax; laterally a broad, slightly oblique pale blue stripe traversing the whole length of mesepimeron.

Legs pale ochreous, hind femora with a small distal point of black on extensor surface.

Wings palely enfumed, hyaline; pterostigma rather longer than broad, costal side slightly shorter than posterior, proximal side very oblique, distal side slightly convex, covering 1 cell, unbraced, brown framed finely in creamy white and thick black nervures; 15-16 postnodal nervures in forewings, 14 in the hind; *Rv+u* arising distad the oblique nervure descending from the subnode; *ac*, midway between the two antenodal nervures or nearer the distal one; *ab* arising from the posterior border of wing well distad of *ac*, very oblique, meeting the discoidal cell near its proximal end, hardly longer than *ac*; *Cu* 8-9 cells long in forewings, 12 in the hind.

Abdomen dark golden brown deepening to blackish brown at apical ends of segments and on the whole of segments 7 to 10; segment 1 with an apical blue annule; 2 with the middorsum narrowly turquoise blue from base nearly to apex; segments 3 to 7 with bright blue basal cordate spots; 8, 9 and 10 pale azure blue on dorsum, the lower parts of sides, especially of 10, black.

Anal appendages blackish brown, apices of superiors paler brown. Superiors broad at base, then tapering strongly till about the middle, the apical half

expanded and curved strongly downward; apex falcate; a very obtuse spine on dorsum at the site of angulation; equal to more than twice the length of segment 10; inferiors equal in length to superiors, very broad at base, then tapered, cylindrical and ending in a fine point which is curved inward; a large robust acutely pointed spine situated at the base, directed inward and upward.

Female. Abdomen 34 mm. Hindwing 23 mm.

Almost exactly similar to the male but the abdomen shorter and stouter. Segments 8 and 10 unmarked with blue; basal blue spots on segments 4 to 6 larger and more conspicuous; wings similar to those of male but *Riv+v* arising rather more distad the subnode; 16 postnodal nervures to forewings, 15 in the hind. Anal appendages short conical pointed, brown; vulvars scales robust but not extending beyond end of abdomen.

Distribution.—Sikkim, Kalimpong, 4,000 ft., Pashoke 3,000 ft., from April to July, in similar situations to those frequented by *Prolosticta*. The beautiful colour complex of this insect will serve to distinguish it from all others of the genus save its near relative *D. polychromatica* from which it is distinguished by its larger size, different character of the thoracic markings, different shape of pterostigma, distal origin of *Riv+v* and longer *Cuii*.

Drepanosticta polychromatica sp. nov.

Male. Abdomen 32 mm. Hindwing 21 mm. (Female unknown.)

Head.—Labium pale brown; labrum, genae, bases of mandibles and anteclypeus palest blue, the former narrowly bordered with brown; rest of head blackish brown as far back as the level of posterior ocelli, at which point is a moderately broad blue transverse band which falls well short of the eyes save for a minute point anteriorly.

Prothorax with dorsum chocolate brown, laterally blackish brown marked on the centre of middle lobe with a narrow yellow line, and on the sides by a broad band of blue extending from anterior to posterior lobe, the latter ochreous on the middorsum and shaped as in *D. carmichaeli*.

Thorax black on dorsum, dark chocolate brown laterally, the former marked with a well-defined narrow blue antehumeral stripe, broad anteriorly where it is confluent with the blue on prothorax, narrowing and tapering to a fine point near the antealar sinus posteriorly. Laterally a sharply-defined oblique moderately broad blue stripe lying just anterior to the posterolateral suture, followed by an equally broad stripe of the ground colour; lower part of metepimeron and beneath thorax pale yellow.

Legs pale ochreous, unmarked. Wings hyaline, palely enfumed; pterostigma almost quadrate, costal side only a shade shorter than posterior, the proximal side but slightly oblique, dark brown finely framed in creamy white and thick black nervures; 15 postnodal nervures to forewings, 14 in the hind; *Riv+v* arising in continuation of the oblique nervure descending from the subnode; *Cuii* only 7 cells long in forewings, 10 in the hind; *ac* lying midway between the two antenodal nervures; *ab* arising from *ac* or more usually from the posterior margin of wing a little distad of *ac* and longer and more oblique than in *D. carmichaeli*.

Abdomen yellow at the sides and beneath, enfumed on dorsum and deepening to blackish brown at apical ends of segments 3 to 6 to form rather sharply defined apical annules; segment 2 with a narrow middorsal streak of blue not quite extending to apical border; segment 3 with a pale blue dorsal basal spot, segments 6 to 7 with narrow pale blue complete basal annules; dorsum and sides of segments 8 and 9 broadly pale azure blue; segment 10 black, unmarked.

Anal appendages black, paler at apices, shaped similarly to those of *D. carmichaeli* but the inferiors stouter and the basal spine less pronounced.

Distribution.—Darjeeling district, Gopaldhara, May to July. Type in the author's collection. Distinguished from all other species of the genus by its colouring and from *D. carmichaeli* by the points enumerated under the description of that species. The sharply defined blue and dark brown stripes on the sides form the best medium for separating these two closely-allied species but in addition it is to be noted that whilst the thorax of *D. carmichaeli* is lighter than that of *D. polychromatica*, the abdomen is strikingly darker; the 10th abdominal segment is blue in the former, unmarked in the latter.

Drepanosticta Viridis Fraser.

Drepanosticta viridis Fras. Mem. Pusa, Dept. Agric. Ind. (Ent.) vol. vii. No. 7. pp. 39, 40 (1922).

Male. Abdomen 50 mm. Hindwing 25 mm.

Head.—Labium palest brown; labrum, bases of mandibles and anteclypeus palest blue, the former bordered narrowly with glossy black; postclypeus glossy black, rest of head steely blue black; eyes pale yellow, capped above with puce; occiput ridged behind as in *Platysticta*.

Prothorax dirty yellow; posterior lobe dark bronzed brown, broadly arched, simple; anterior lobe collar-like.

Thorax dark metallic green or blue on dorsum changing to reddish brown at humeral region and pale brownish yellow laterally. Lateral sutures mapped out obscurely in pale brown, the anterior suture bordered broadly and diffusely with black. Beneath yellow.

Legs yellow with black spines; extensor surfaces of femora blackish brown, tibiae olivaceous.

Wings hyaline; pterostigma reddish brown, very small almost quadrate, costal border but slightly shorter than posterior, distal border convex, proximal but slightly oblique; 14 to 15 postnodal nervures to forewings, 14 in the hind; *ac* lying much nearer the level of distal antenodal nervure; *ab* arising from posterior margin of wing well distad of *ac*, very short, hardly longer than *ac*; *Riv* + *v* arising well distad of the oblique nervure descending from the subnode.

Abdomen of great length, very slim, resembling species of *Protosticta* more closely than any other species of the genus. Segments 1 to 7 brownish black, this colour deepening at apices of segments 2 to 7 but falling short of bases of segments where are seen narrow white basal annules; segment 8 with the basal half azure blue on dorsum, black laterally and middorsally so that the blue of apex presents two points directed basad subdorsally; segment 9 entirely pale azure blue on dorsum, segment 10 black, emarginate and with a deep depression on dorsum extending nearly as far as its base.

Anal appendages black; superiors twice the length of segment 10, bent at a right angle at their middle, downwards and a little inwards, broad at base, presenting a needle-like dorsal spine at the point of angulation; apex expanded, bevelled at end. Inferiors nearly as long as superiors, broad at base, then flattened, twisted spirally on their long axis at the middle of appendages, apical half angulated sharply upwards to meet and overlap apices of superiors; a small needle-like spine on the inner border, directed inwards near the middle of appendages.

Female. Abdomen 37 mm. Hindwing 25 mm.

Closely similar to the male in colour and markings but shorter and more robustly built. Segments 8 and 9 without blue markings; segments 1 to 6 with well-defined basal white annules, 7 without, otherwise all details, including venational ones similar to those of male.

Distribution.—King Island, Mergui, Lower Burma. Found beside marshes and small irrigation channels and streams in rubber plantations. Distinguished from all other species of the genus by the extreme length and attenuation of its abdomen which is exactly double the length of the wings as in species of *Protosticta*. The armature of the anal appendages recalls that of *P. himalaica*.

Drepanosticta Quadrata (Selys.).

Platysticta quadrata. Selys, Bull. Acad. Belg. (2) x. p. 441 (1860); Id. Syn. Agr. Dernière Legion. sep. p. 13 (1860); Id. Ann. Mus. Civ. Giv. Genov. (2) x. xxxii. pp. 507, 508 (1891); Kirby, Cat. Odon. p. 133 (1890); Laid. Fascic. Malay. Zool. Pt. iv. p. 11. fig. 1 (1907).

Drepanosticta quadrata. Laid, Rec. Ind. Mus. vol. xiii. p. 343 (1917); Id. Journ. Malay. Roy. Asia. Soc. vol. ii. pp. 304-306 (1924).

Male. Abdomen 35 mm. Hindwing 21 mm.

Head.—Labrum, bases of mandibles and anteclypeus palest blue, the former broadly bordered with glossy black; postclypeus and rest of head black. Prothorax creamy white; posterior lobe black, simple.

Thorax bronzed black on dorsum, pale bluish laterally, pale yellow beneath. Laterally an oblique black stripe traversing the length of mesepimeron.

Legs pale, the extensor surfaces of femora and articulations black.

Wings hyaline; pterostigma subquadrate, black, finely framed in white and thick black nervures; *Riv+v* arising slightly distad the oblique nervure descending from the subnode; 11-12 postnodal nervures in forewings, 10-11 in the hind.

Abdomen blackish brown, segments 2 to 7 with a narrow yellow basal annule, the black expanding at apical ends of each segment to form broad apical annules; segment 8 with the apical half and 9 with the whole of dorsum pale blue; segment 10 black.

Anal appendages black, superiors twice as long as segment 10, slightly curved towards each other and downwards, a robust spine on the upper border of middle of appendage, apex slightly flattened and dilated. Inferior appendages of similar length, pale at base which is broad and presents an inner upper obtuse spine or tubercle, then tapering, subcylindrical, apex curved in, notched and preceded by a long inner spine.

Female. Abdomen 31 mm. Hindwing 18 mm.

Head.—Labrum dirty white; anteclypeus pale yellow; postclypeus and front of frons traversed by an obscure band; rest of head black.

Prothorax pale yellow; posterior lobe emarginate at middle, yellow with obscure greyish fascia.

Thorax bronzed black on dorsum as far lateral as the antero-lateral suture, the middorsum greyish yellow. Laterally and beneath pale yellow with a broad oblique brown stripe traversing the mesepimeron. Legs pale yellow, articulations obscure.

Wings similar to the male but *Riv+v* arising in continuation with the oblique nervure descending from the subnode.

Abdomen brownish black, segments 2 to 7 marked similarly to the male; segment 9 yellow on dorsum, 10 black.

Anal appendages short, conical, black. Vulvar scale robust.

Distribution.—The type comes from Singapore but it is by no means certain that the allotype female from Burma (Teneral and in poor condition) belongs to it, the probability being otherwise. The female, taken on Mt. Karen in May, has the paler yellow markings probably pale blue in the adult stage.

Drepanosticta Annandalei Fraser.

Drepanosticta annandalei Fras. Rec. Ind. Mus. Vol. xxvi. pp. 412, 413 (1924).

Male. Abdomen 32 mm. Hindwing 22 mm.

Head.—Labium brown; labrum, bases of mandibles and adjacent part of anteclypeus palest blue, the former narrowly bordered with glossy black; postclypeus and rest of head matt black; basal and 2nd segments of antennæ white; eyes olivaceous brown above, paler beneath.

Prothorax brownish white with a large black spot on each side; posterior lobe simple, rounded.

Thorax blackish brown on dorsum with the middorsal carina and upper part of humeral suture paler. Laterally white with a diffuse brown fascia traversing the sides obliquely as far as metepimeron.

Legs creamy white; femora on extensor surfaces stippled with black; tibio-femoral joints black.

Wings hyaline; pterostigma blackish brown, shaped similarly to that of *D. carnichaeli*; 16 postnodal nervures to forewings, 14 in the hind; *Riv+v* arising in continuation with the oblique nervure descending from the subnode; *ab* very oblique, arising from posterior border of wing somewhat distad of *ac*.

Abdomen creamy white laterally and beneath, black on dorsum, the black not extending to extreme base of segments but expanding apicad to form broad annules; segment 8 white or pale blue for its basal two thirds but the black of the apical third extending finely along the middorsal carina as far as base of segment; segments 9 and 10 black, unmarked with blue.

Anal appendages black, slightly longer than segment 10, the inferiors slightly shorter than superiors. Superiors broad at base, rotated on their long axis at the middle at which point they curve somewhat inwards and strongly

downwards; apices obtuse and slightly bevelled. Inferiors broad at base, then tapering, cylindrical, ending in an acute point.

Female. Abdomen 25 mm. Hindwing 20 mm.

Very similar to the male but abdominal segment 8 black for its apical half; segment 9 with the basal two-thirds white (or blue) apical third black. Anal appendages short, conical, pointed, pale; vulvar scale robust, not extending beyond end of abdomen.

Distribution.—Andamans only. Type in the Indian Museum from Mt. Harriet, 800 ft. South Andamans, taken in deep jungle at edge of a stream in December. Its simple black colour with white and blue markings serves to determine it from *D. carmichaeli* and *D. polychromatica* whilst the comparatively short abdomen will separate it from *D. viridis*. Its extremely simple anal appendages will distinguish it from *D. quadrata* as well as from other Malayan species of the genus.

In the original description I compared this species with *D. hilaris* from Burma, whereas *D. quadrata* was of course intended.

(To be continued.)

INDIAN NET-VEINED MIDGES OR BLEPHAROCERIDÆ

(INSECTA: DIPTERA).

BY

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(With one plate and four text-figures).

The Blepharoceridæ or Net-veined Midges are of special interest to a student of Animal Adaptations and Evolution. These insects comprise an archaic family of Nemocerous Diptera whose affinities are still a matter of conjecture. They are highly specialized for life in swift currents during all stages of their development. In the course of my work on torrential populations¹ I became greatly interested in the larvæ and pupæ of the Blepharoceridæ and have made a representative collection of the group at Dumpep and Shillong in the Khasi Hills, in the Teesta-Valley below the Darjiling Himalayas and at Dalhousie and Chamba in the Western Himalayas. Dr. A. L. Tonnoir² has worked out this collection and has come to the conclusion that the Blepharocerid fauna of India "is certainly the richest of the world in the number of Genera". He has described two new remarkable genera—*Horia* and *Euliponeura*. Dr. Tonnoir has expressed a hope that his paper "will stimulate the collectors in the Indian region to pay more attention to those interesting flies". It may be pointed out here that the Blepharoceridæ seem to be fairly well represented throughout India, for, a few specimens have been brought back by the Zoological Survey parties from the Nilgiris, the Simla Hills and Burma. No systematic collection has, however, been made in any part of India, except in the three regions mentioned above.

The object of this short note is to bring to the notice of likely collectors the general form and habitat of these interesting flies.

Of all the animals that inhabit the torrential streams of India the larvæ of the Blepharoceridæ are the best adapted to hang on to bare rocks in the most tumultuous situations. They "like the lip of a fall, the rocks of cascades, and the sides of a pot-hole in which the water is ever whirling and boiling".³ They always

¹ Hora, S. L., *Phil. Trans. Roy. Soc. London*, Series B, CCXVIII, pp. 171-282 (1930).

² Tonnoir, A. L., *Rec. Ind. Mus.*, XXXII, pp. 161-214 (1930).

³ Kellog, V. L., "Diptera. Fam. Blepharoceridæ". "*Genera Insectorum*", Fasc. LVI, p. 3 (1907).

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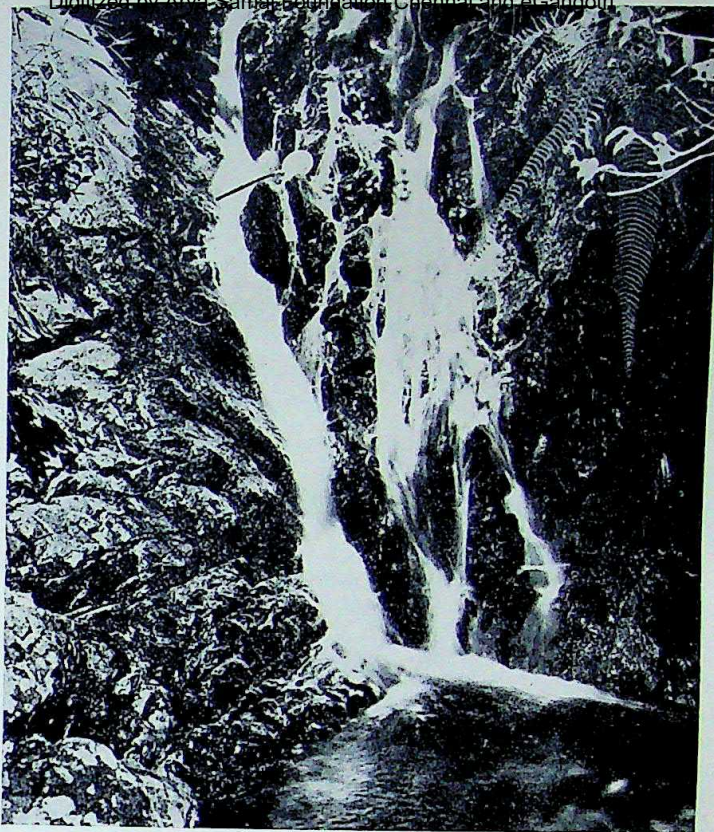


Fig. 1. A fall in the course of a small stream below Shillong-Cherrapunji Road $\frac{1}{2}$ mile beyond Dumpep, Khasi Hills, Assam.



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 Fig. 2. Stream below Umdong fall near Dumpep, Khasi Hills, Assam.
 D. Bagchi Photo.

live on bare rocks (not overgrown with slimy matter) but naturally the habitat of the different species is different. Some live on stones and rocks forming the bed of a torrent, others prefer lips of falls, while there are some that live on rocks at the base of falls over which water falls with a tremendous crash. Usually the larvæ live in large number in one place and form black patches on the rocks. Each larva is a small animal only a few millimetres in length, oval in outline with the body slightly depressed. By virtue of half a dozen ventral suckers, each of which is capable of powerful and independent attachment to the stones, these larvæ manage to live in the swiftest part of the current. The suckers have become so important that the body has become segmented secondarily, so that the major divisions of the body conform to the suckers and not to the original body segments. In some forms (fig. 1) the body is constricted between these divisions and the lateral appendages are well-marked, while in others a regular limpet-shaped form is attained (fig. 2).

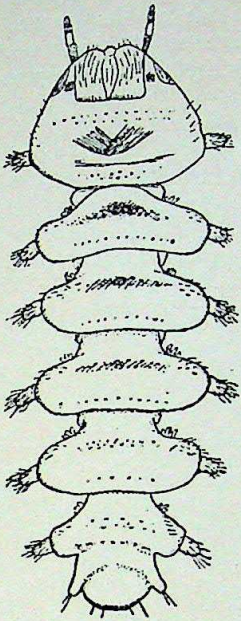
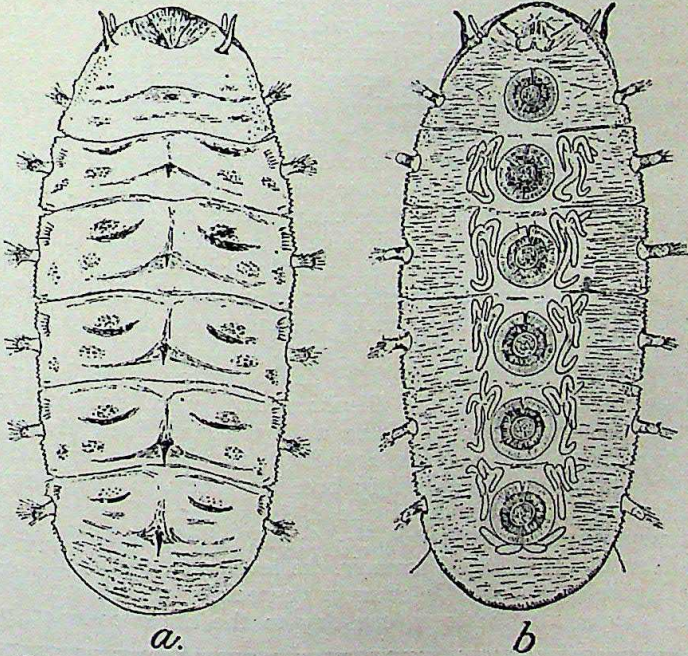


FIG. 1.

Larva H. (after Tonnoir).

FIG. 2. Dorsal (a) and ventral (b) views of Larva R1, of *Horiaia* (after Tonnoir).

A pupa (fig. 3) of the Blepharoceridæ is roughly oval in outline, is strongly convex on the dorsal surface and flat on its ventral surface by which it adheres. Each pupa is fastened to the rocks by six pads, three on each lateral margin of the ventral aspect

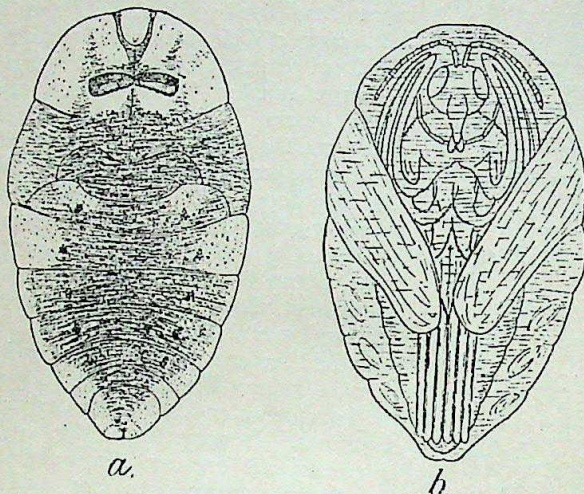


FIG. 3. Dorsal (a) and ventral (b) views of Pupa I of *Euliponeura horai* Tonnoir (after Tonnoir).

of the abdomen. The pupæ, like the larvæ, are found closely clustered together with the head pointing downstream. According to most writers pupæ live in similar situations as the larvæ but Hubault¹ has observed them actually preferring swifter currents than those in which the larvæ live. My observations are different. About the time of pupation the larvæ seek comparatively sheltered places and generally pupate in such situations where they are kept moist either by the dribbling of the water or by the spray of a fall. I have collected pupæ from the under side of the rock forming the lip of a fall and from the face of a cascade behind the column of falling water. In a small stream flowing through the Teesta Bazaar, Mr. Hodgart, the field-collector of the Zoological Survey, obtained pupæ from the exposed surfaces of rocks and stones living in similar situations as the larvæ.

Dr. Tonnoir has sent me the following valuable information regarding the habitat of the Blepharocerid pupæ studied by him under natural conditions: "I have always found *Edwardsina* pupæ under the water, *Neocurupira* and *Peritheates* pupæ can live right under the water as evidenced by breeding them in aquarium; but the latter are found sometimes out of the water. The same applies to *Paracurupira*; *Apistomyia* were found mostly out of the water but in New Zealand and Tasmania the level of the mountain creeks is varying so much even in summer (especially on the west coasts) that the pupæ may be from one day to the other completely sub-

¹ Hubault, E., Bull. Biol. France Belgique, Supp., IX, p. 304 (1927).

merged or well above the water level and sometimes not even kept moist by the spray".

It is clear from the above that a collector must look for the pupæ in all kinds of possible "niches" in close proximity to the falls where the larvæ live.

I have not been very successful in collecting the adult flies of this family. "The imagines have very long, slender hind legs, and cling to the wet rocks with all six legs spread widely out. Their wings are held out at right angles to the body and in line with one another; this habit enables the collector at once to distinguish a Blepharocerid from various forms of Tipulidæ which frequent similar situations, but which always rest with the wings folded down the abdomen"¹. Another character, by which a collector can distinguish flies of this family, is the secondary net-veining

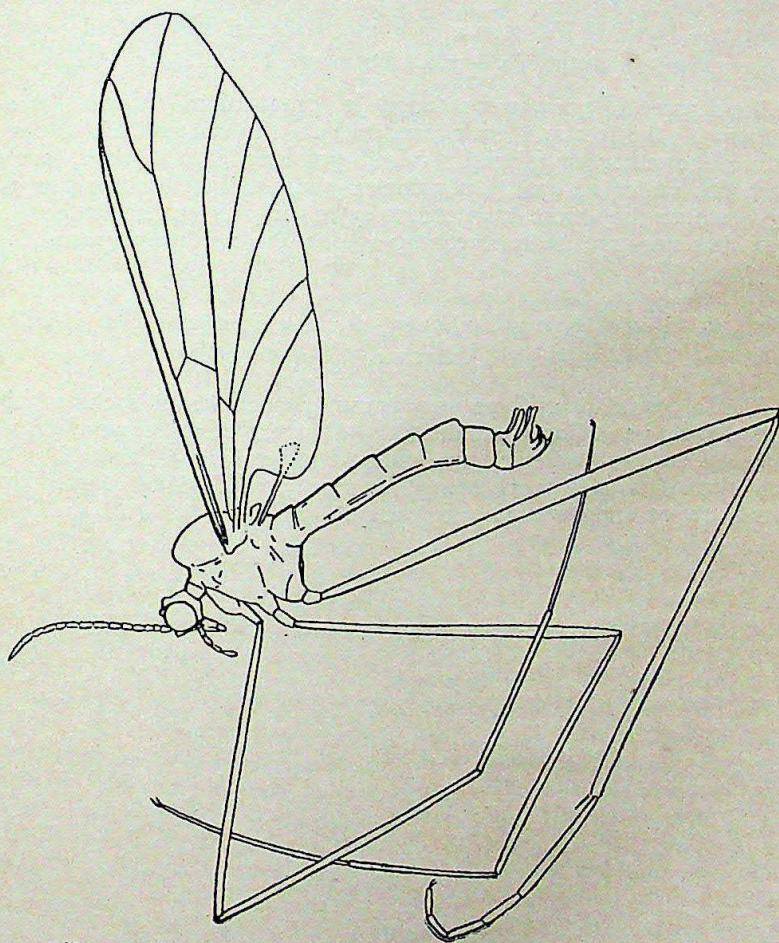


FIG. 4.—Male of *Euliponeura assamensis* Tonnoir (after Tonnoir).

¹ Tillyard, R. J., *Australian Zoologist*, II, p. 159 (1922)

and the petiolate condition of the wing. According to Tillyard the flies are very tame and "can be easily caught either with a forceps or with the fingers, though they should be approached without unnecessarily irregular movements". I collected two specimens of *Apistomyia* drifting up stream in the evening along the rapids above the falls of the Punj-pul stream at Dalhousie. A few flies—*Blepharocera*, *Horaia* and *Euliponeura* (fig. 4)—were collected by sweeping among overhanging plants near waterfalls in the Khasi Hills.

So far as my experience goes these interesting insects can be collected in India at all times of the year, but spring is believed to be the most favourable time.

EXPLANATION OF PLATE

Fig. 1.—A fall in the course of a small stream below Shillong-Cherrapunji Road $\frac{1}{4}$ mile beyond Dumpep, Khasi Hills, Assam.

Blepharocerid larvæ were found in great abundance on such portions of the vertical rock over which the water fell. Pupæ clustered together on slightly raised portions of the rock, such as the one indicated by the position of the small net in the photograph, where they were kept moist by a spray from the waterfall. A few flies were netted by sweeping among the overhanging bushes.

Fig. 2.—Stream below Umdong fall near Dumpep, Khasi Hills, Assam.

Blepharocerid larvæ were very common on sides of rocks which formed rapids and lips of small falls. Clusters of pupæ were found above the level of water on the sides of rocks marked with X. In such situations they were being constantly washed by the eddies of the current and kept moist by spray.

THE PROBLEM OF EVOLUTION.

BY

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PART II.

(With a plate).

(Continued from page 131 of this volume.)

THE TREND OF EVOLUTION UNDER NATURAL CONDITIONS

The theory of evolution is based on one proved fact and one assumption, namely (1) that living matter exhibits definite variations, whether these be of the nature of small and gradual alterations or of larger and more obvious changes that may be inherited and are termed mutations; and (2) that nature has exercised and presumably still exercises a selective choice among living organisms as a result of changing conditions of time and space combined with competition. I do not propose to discuss here the causes of these variations and mutations but it seems to me that such departures from the normal must ultimately be the result of external conditions that act on the organism, and, further, we must bear in mind that the primary cause may have acted on the immature or larval stage of an animal and not on the adult, and that the effect may not become visible until the next or possibly even the 2nd generation. Garstang¹ claims as examples of this early action that the Order Gastropoda in the Mollusca originated by a change, to wit, the torsion of the body, that first arose in the free-swimming larval stage of development; and that the differentiation of such genera as *Emarginula* and *Fissurella* were equally brought about by a larval mutation, these changes being handed on to the adult. Willey² has also emphasised the view that "Larvæ are the vehicles of the future rather than the relics of the past". In any case varieties or mutations arise from the parent stock and according to the Darwinian theory their survival will depend on the value or otherwise of the alteration; if the variation is an advantage to the species then it will be preserved. Darwin³ himself remarks, "It is, as I can see now, probable that all organic beings, including man, possess peculiarities of structure, which neither are now, nor were formerly, of any service to them, and which,

¹ Garstang, W., 1928. "Origin and Evolution of Larval forms." British Association, Section D. Zoology. Glasgow.

² Willey, A., 1911. *Convergence in Evolution*, p. 41. London.

³ Darwin, Charles, *Descent of Man*, pp. 61, 62. 2nd Edition, 1896.

therefore, are of no physiological importance. We know not what produces the numberless slight differences between the individuals of each species . . . ; but each peculiarity must have had its efficient cause. If these causes, whatever they may be, were to act more uniformly and energetically during a lengthened period, the result would probably be not a mere slight individual difference but a well-marked and constant modification though one of no physiological importance." Twice in thirteen lines Darwin asserts that these changes may be of no physiological importance; but can any change, accompanied as it must be by other changes in the complete organism, be of no importance, physiologically or otherwise? The advocates of the Darwinian theory of Evolution and those of the Mutation theory appear at first sight to be in the main in complete opposition in their views regarding the effect of environment on the race. According to Darwin, animals are always tending to vary and if the variation is beneficial then external surroundings will by selection perpetuate and even intensify such modification, till we ultimately get a new species established. The Mutationists, however, hold the view that the change of structure or function is inherent in the egg and the effect of environment on a favourable mutation will be to fix it and eliminate all those other forms that tend to vary from the mean. These views regarding the effect of the surroundings on the individual are, however, not so diametrically opposed as at first sight they appear to be; but neither view formulates any ultimate cause for the variation or mutation, or, in other words for the actual evolution of new forms.

Evolution, as I understand it, is the response of the living organism to the outside influences that constitute its environment and this response may be in one of two directions. In the early stages of evolution or in the early stages of development in those animals in which evolution has already advanced to a considerable degree and which we in consequence term higher animals, the actual external conditions themselves appear to have acted upon the organism, producing changes in the genital cells and thus giving rise to forms that differed from their parents and, if those influences affected the chromosomes of the nucleus of the germ cells, the change in bodily form was inherited and we get what is termed a mutation. Bather¹ in his address to the Geological Society in 1928 asks "Why do mutants so often assume the same characters as the adaptive modification? Does the influence that produces the modification also induce a change in the germ, and, if so, why is that change in the same direction as the modification?" He suggests that there is some physico-chemical factor in the body that will be found to be capable of producing the same effect on the germ cells as on the body itself; but without actually adopting this view, though it is, I think, extremely probable, we must not overlook the fact that while changed surroundings may produce mutations in a number of different directions, it is only

¹ Bather, F. A., 1928. "The Fossil and its Environment." Annual Address to the Geological Society, London.

those that are of direct utility to the animal or, in other words, those that approximate to the modification that will be able to survive and thus become known to us either by their presence in animals in the living state, or by their presence as fossils in the various strata in sufficiently large numbers to have ensured their subsequent discovery and thus to afford the proof that at one time they did survive the changes in their surroundings. Whatever the actual process may be, there can be but little doubt that there is a close connection between the surroundings and the bodily characters. As Baker¹ remarks, "Some Zoologists—especially Ecologists—may affirm that the environment, in directing evolution, does in fact cause the change, as for example, when a normal river or creek species is forced to inhabit a lake, and in a sense this may be true, the changed environment *compelling* the organism to change its structure so that it may be in harmony with the changed conditions." My colleague, Dr. Hora², has made a special study of the similarity of structure in those animals that inhabit torrential streams, and the same close resemblance can be seen in those animals that have respectively adopted an arboreal existence, a borrowing form of life, or an aquatic habitat, etc. A comparatively short change of environment may be sufficient to produce a similar change in different animals. During the last year Le Souef³ has given a very interesting account of the changes that have taken place during the last 60 years in certain species of Wallaby that were introduced from Australia into Kawan Island, near Auckland, New Zealand; four species were introduced and in three of these exactly the same evolutionary changes have now taken place; the fur has become longer and more silky, the colouration is darker and the markings have become more pronounced. The fourth species is, as yet, unchanged. Exactly similar changes have occurred in Opossums that were introduced into New Zealand; here also the fur is longer, more silky and less dense and these changes are so marked that New Zealand skins can be distinguished among thousands of others that are offered for sale. We have here a very clear instance of identical changes being caused in certain characters of species belonging to different Sub-orders of the Marsupialia as a result of introduction into the same conditions of life.

In the present state of our knowledge it is not, however, always possible to correlate similar variations in different species with similar changes in the environment; as an example I may cite the change from a distome form to a monostome in some of the larvæ of the Digenetic Trematodes.⁴ In every case these larval forms

¹ Baker, F. C., 1928. "Influence of a changed environment in the formation of new species and varieties." *Ecology*, Vol. ix, No. 3, p. 271.

² Hora, S. L., 1930. "Ecology, Bionomics and Evolution of the Torrential fauna, with special reference to the organs of attachment." *Phil. Trans. Royal Soc. London. Series, B.* Vol. 218, pp. 171-282.

³ Le Souef, 1930. *Australian Zoologist*, Vol. vi, p. 111. (I have not been able to refer to this paper. R.B.S.S.)

⁴ Sewell, R. B. S., 1930. "The Evolution of the Excretory System in certain groups of the Furcocercous Cercariae." *Rec. Ind. Mus.*, Vol. xxxii (in the Press).

pass through a stage, known as the Cercaria, in which they leave their first host, a Mollusc, and take to a free-swimming life. So far as one can judge, there can be but little difference in their surroundings and yet in five or six instances there has occurred, quite independently, a suppression of the posterior or ventral sucker. A somewhat similar phenomenon, met with in certain other groups of the animal kingdom, is the progressive variation, or the waxing and waning of what Metcalfe¹ terms "trends." These trends may arise in certain families and are not, apparently, directly connected with the external surroundings though their inception must, I think, have some ultimate external cause. The examples that Metcalfe quotes are certain planktonic organisms or intestinal parasites, both of which live under conditions as stable as one is likely to find anywhere in nature. These trends are tendencies to vary in a particular direction and may possibly be the result of a physiological mutation, but even so they appear to have periodic fluctuations, rising to a maximum and then waning again; and they may for a time even be suppressed altogether but only to appear again later. Such trends act and behave like other characters of the body; and, like many other characters, they tend to appear in subsequent stages of evolution at an ever earlier stage of development and in some instances may, as a result of this, actually become harmful to the race.

Within recent years it has been shown that changes in environment may be accompanied by and in all probability themselves produce physiological alterations in the body without causing any corresponding morphological change, except possibly, one of bodily size; in such cases even a detailed and careful examination fails to reveal any difference in the structure of the various parts of the organism, even the proportional sizes of the various parts remaining the same. We thus get the formation of physiological or, as they have been termed, Biological races within the limits of the same single morphological species. Such races may be induced by a variety of causes, such, for instance, as:

- (1) changes in the external temperature conditions.

Individuals of a species may become acclimatised to either high or to low temperatures and yet be unable to stand any sudden change. In such cases individuals adapted to higher temperatures are unable to inter-breed with those living at a lower temperature. Exactly similar changes may be induced by

- (2) changes in the pH concentration of the surrounding medium, or,
- (3) changes in Salinity.

Again, we may get changes in the physiological conditions of the animal itself, as for instance—

- (4) differences in the time of ripening of the genital organs, or differences in habits during the breeding season, or,

¹ Metcalfe, M. M., 1928. "Trends in Evolution: A discussion of data bearing upon 'Orthogenesis'". *Journ. of Morphology and Physiology*, Vol. xlv, p. 1.

- (5) in the nature of the food and the resulting differences in the vitamin supply that may cause a difference in the bodily size.

Any of the above causes may prevent the fertilisation of the females of one race by the males of another, and we should thus get a physiological isolation, the effect of which will be quite comparable, so far as the production of new species is concerned, to that produced by spatial isolation.

There is also a growing mass of evidence that, quite apart from any possible effect that it may have on the germ cells, an alteration in the environment, using this term in its widest sense, may produce an effect on the body as a whole and also on certain groups of cells or organs within the body and may thus affect the future structural and physiological condition of the organism. In this connection it is interesting to note the very small limits of the physical conditions within which life is possible. The known range of the thermometer extends from -273°C to the upper extreme that lies far beyond the condition known as white heat, approximately 2000°C ; yet living organisms can only exist between the ranges of 0° and 100°C . As Coleman¹ has pointed out, liquid water is essential for the continuance of life. In some of the lower organisms the individual can withstand being frozen for a short time, and in the higher or warm-blooded animals their bodies can for varying periods withstand an exposure below 0°C , but only because the body retains its own temperature and thus prevents the water in the system from freezing; water as a gas and water as a solid will not serve the purpose of life, it must be in a liquid condition. Doubtless changes in the external conditions can be met by living organisms in a variety of ways and in my Presidential address to the Indian Science Congress last month I put forward evidence to show that either external conditions, using the term in its widest sense, or the internal conditions of the parent may so affect the developing animal as to cause the appearance of new characters. Many of these changes are small and of but little concern to the animal; yet, by the summation of such characters brought about by natural selection, we may ultimately produce a very marked change. Sewertzoff² has classified the evolutionary changes that occur in the animal kingdom into four groups:

- (1) Aromorphoses, or changes of both the structure and function of organs or progressive evolution;
- (2) Idio-adaptations, or specialised adaptations to changing surroundings;
- (3) Coenogenesis or embryonal adaptations; and
- (4) Degeneration.

These two latter groups of changes are of a somewhat specialised kind and I do not propose to consider them further; the other two seem to me to differ from each other in degree rather than in kind. In both cases they are the responses of the body to altered environment and in the case of the Aromorphoses, that led to the

¹ Coleman, A. P., 1926. *Ice Ages. Recent and Ancient*. New York.

² Sewertzoff, H. N., 1929. "Directions of Evolution," *Acta Zoologica*, Vol. x, p. 59.

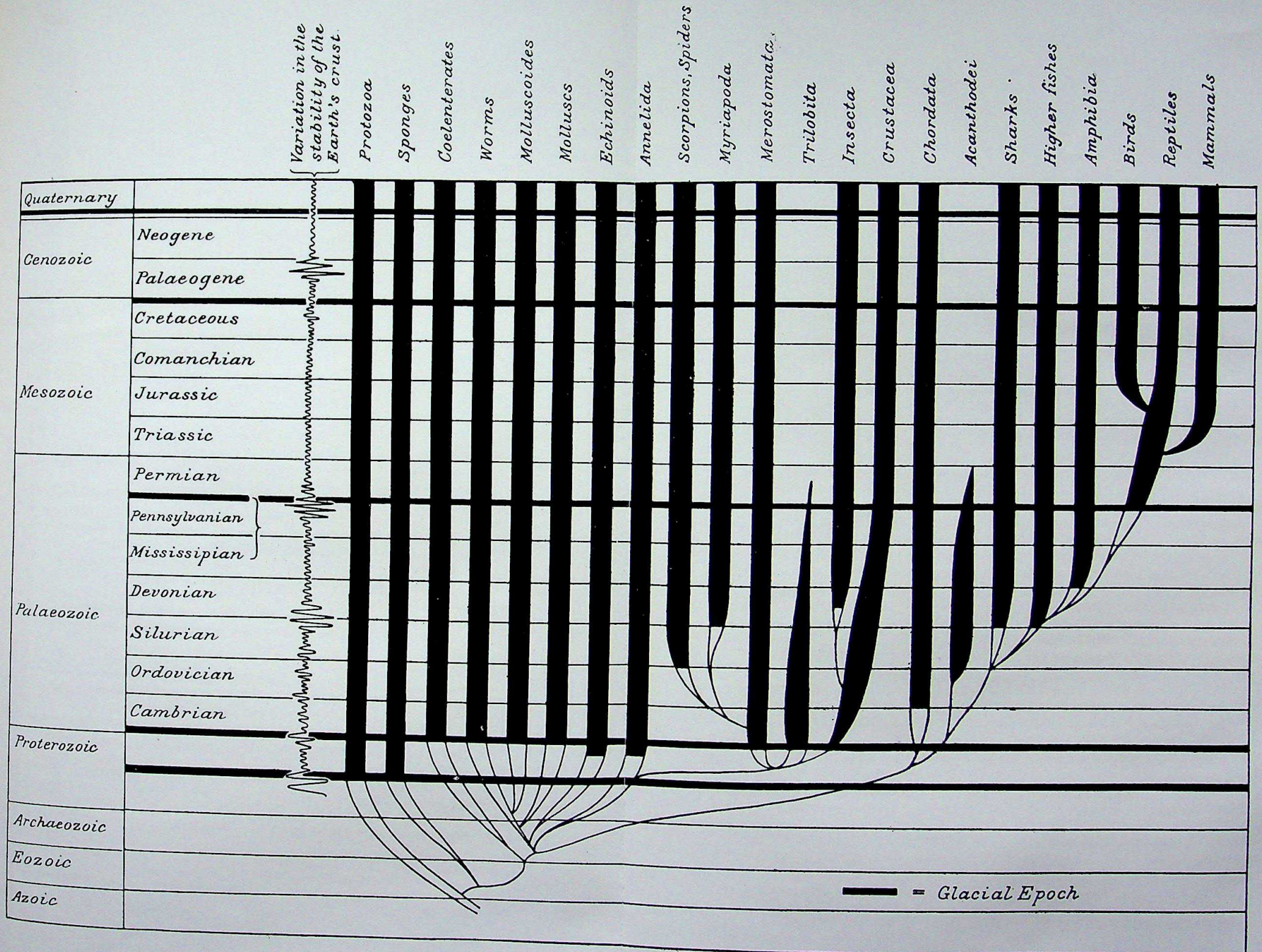
origin of the great groups of the animal kingdom, occurred for the most part, if not entirely, at those periods of the world's history when the earth itself was undergoing profound changes in its physical condition. There is among some zoologists and especially among those who have attempted to study the Psychology of the lower animals a growing tendency to regard the animal's own initiative as one of the most important factors in the evolution of the race, though some appear to me to press the argument too far. One cannot but admit that a change of function in an organ, such as Sewertzoff postulates in the "aromorphoses", must in many cases have been due to a large extent to the animal's own activities. The change from a simple branchial skeleton supporting the gill arches in the primitive chordate to a definite mechanism for capturing prey, with its upper and lower jaws, must very largely have depended on the efforts of the animal and its use of the anterior arches as a prehensile mechanism; again, in the torrent-inhabiting forms, the development of a flattened body or prehensile claws, that enable the animal to lie close against the surface of, or to cling to, a rock and thus allow the rush of water to pass harmlessly by, could only have possessed survival value if the animal had adopted a rock-frequenting habit, and it is possible that in a dim and smaller degree the same initiative was active in the production of new forms among the lowest animals.

Bidder has recently pointed out that a small change in the animal's structure or physiology, that under normal conditions may be neither useful nor harmful, may, during the occurrence of a "cataclasm", become the deciding factor whether the possessor shall survive or not; and if these cataclasms are repeated, even if only at intervals of such immense length as 50,000 years, they will have a great effect on the preservation and in determining the character of the surviving fauna. Such cataclasms or rather cataclasmic periods seem to have occurred in the earth's history on five different occasions, in most cases associated with a definite Glacial Period, and at or closely following each successive cataclasmic period there was a considerable development and evolution of animal forms. In the accompanying chart I have attempted to show graphically the time in the history of the earth at which the great groups of the animal kingdom came into existence and you will at once notice how early many of these great groups made their appearance. The figure is based on a chart recently published by Matthew¹, showing the probable Geological period in which each of the main phyla arose, modified in places in accordance with the views of Chamberlin and Salisbury², while on the left hand side, the wavy line, showing the periods of instability of the earth's crust is taken from Dudley-Stamp³. Life probably began on the earth at some stage of the Eozoic or possibly even in the Azoic Era, though up to the present time the earliest

¹ Matthew, W. D., 1930. "The Pattern of Evolution". *Scientific American*, Sept., p. 192.

² Chamberlin and Salisbury, *Geology; Earth History*. London.

³ Stamp, L., Dudley, 1923. *An Introduction to Stratigraphy*, Fig. 4, p. 19. London.



fossils that have been discovered are from the Proterozoic Era. In the Huronian period of the Proterozoic Era we get the first great period of instability and glaciation, and immediately following this we find that by the end of the Proterozoic period evolution had advanced so far that the Protozoa, Sponges, Coelenterates, Echinoids, Annelid worms, Crustacea, Pteropods, and Molluscoides had all definitely made their appearance. At the close of the Proterozoic Era in the Precambrian period there was a second Glacial Epoch and immediately following this in the Cambrian we get evidence of the existence of Gastropod and Lammellibranch Molluscs, while in the periods that follow we find the existence of Cephalopods, Chordata, and Vertebrates in the form of Fish; while at the close of the Silurian period there is evidence of another period of instability of the earth's crust, though in this case unaccompanied by any glacial epoch, and we now find the remains of Crinoids, Reef-forming Corals, Arachnids (Scorpions, Spiders) and in the Devonian Period of Insecta and Amphibia. Following on the Carboniferous (Pennsylvanian) Period of the Palaeozoic came the third great glacial epoch again accompanied by a period of instability of the earth's crust and this is followed in the Permian by the appearance of Reptiles, while the Triassic and Jurassic Periods of the Mesozoic saw the commencement of the Birds and Mammals. From this stage there has been no new appearance of Classes or Orders and for the most part evolution has been limited to the appearance of new genera or species. The effects on the animal population of the globe of this Carboniferous glacial epoch are summed up by Coleman¹ in the following words: "The Palaeozoic, the time of ancient life, ends with the Permian, when most of the formerly dominant types of living beings disappear or lose their importance, leaving the way open for new types to take their place. This is true of land and sea and air. It was too serious an ordeal for many creatures adjusted to warm waters, and we find that Trilobites vanish, Corals and Brachiopods diminish greatly and few of the many primitive sharks of the Palaeozoic seas survive. The antiquated Ganoid fish with bony scales or plates almost disappear. In their place come the more modern and adaptable molluscs, Ammonites, bony fish, and great marine reptiles. On the land the giant spore-bearing plants, horse-tails, ground pines and tree ferns lose their supremacy and give place to Conifers and Cycads, the forerunners of Mesozoic forests. Among the Cryptogamic trees, there were many strange insects, including forms like dragon-flies with a two-foot spread of wings. The climax in size of the lower forms of plant and animal life, the spore plants and the insects, passed with the long winter of the Permocarboniferous Ice Age, leaving the way clear for the flowering plants and flying vertebrates, such as the Pterodactyls and the birds with teeth of the Mesozoic. On the land the small reptiles which survived the cold rapidly multiplied and expanded into the dinosaurs, which ruled the renovated continents after the Ice Age disappeared."

¹ Coleman, A. P., 1926. *Ice Ages. Recent and Ancient*. New York.

Matthew¹ remarks "the period was a most important and critical one in the evolution of land life for it witnessed the first great expansion of land vertebrates and the origin, probably, of mammals, birds, and the principal orders of reptiles, including dinosaurs."

The huge dinosaurs were, again, in their turn, destroyed by or, at any rate, at about the time of the Glacial Epoch in Eocene times and finally it was the Glacial Epoch in Pleistocene times that gave Man his opportunity and led to the evolution of *Homo sapiens* from some primitive ancestor, such as *Homo heidelbergensis* or *Homo neanderthalensis*.

I would remind you that the date assigned to the first appearance of these great groups of the animal kingdom is dependent on the discovery of fossil forms in the various strata and it may be that future researches by geologists will throw the origin of some of these groups even further back. All that we can definitely state at the present time is that each of the groups are known to have been in existence at the period indicated. In this connection I may refer again to the recent publication by Matthew¹ who believes that nearly all the great groups originated at about the same time in the Precambrian era; Austin Clark² has recently suggested that the main evolutionary divisions took place at an even earlier stage. He postulates that "from the single cell life, at its very first beginnings, developed simultaneously and at once in every possible direction. All of the phyla or major groups seems to be a simultaneous development. From each one of them a separate evolutionary tree arose, growing upwards through the ages." He maintains that so far back as Cambrian Times, at least, the major groups of animals bore the same relationships to each other that they do to-day and moreover that this Cambrian era is much nearer to the present epoch than it was to the far distant time when life on earth began. Dr. Hans Przibram³ throws the great changes in evolution even further back, and suggests that every species of Metazoan has been derived, independently of all others, from a distinct species of Protozoan. Whichever of these views be right there seems but little doubt that each successive Glacial Epoch or period of instability of the earth's crust has been responsible for less and less advance in the evolutionary scale. No great group has appeared since the Jurassic and Triassic Epochs, when the Mammals and Birds first arose from the Reptiles, and by attaining to the condition of Homoiothermy or warm-bloodedness were able to dominate all the other groups of the animal kingdom.

As Langdon Brown⁴ has recently pointed out, "the most striking thing about protoplasm is its incessant urge to assert itself as strongly as its environment will permit. This is the real struggle for existence. . . The whole story of the multicellular organisms

¹ Matthew, W. D., 1923. "Recent Progress and Trends in Vertebrate Palaeontology." *Bull. Geol. Soc. Amer.*, Vol. xxxiv, p. 404.

² Austin H. Clark, 1930. "Zoogenesis" *Scientific American*, Aug., p. 104.

³ Przibram, H., *Rev. Gen. Sci.*, Vol. xi, No. 10, p. 293. (I have not been able to refer to this paper. R.B.S.S.)

⁴ Langdon Brown, W., 1930. "On Clinical Psychology" *St. Bartholomew's Hospital Journal*, Vol. xxxvii, No. 10.

is one of mutual adjustments between the different tissues, each trying to do the best for itself within the limits of those adjustments. And, similarly, the individual composed of such tissues struggles to achieve the best it can within its environment, or to change into a more favourable one. The dipnoid fish, gasping for breath on the mud-flats and struggling with its spiky fins to reach the land, was, no doubt, actuated by the need to escape from the competition of life in the sea towards the abundant food-supply on the land. From that successful struggle all the land Vertebrates and ultimately man himself arose." A study of the changes that have been carried out in this process of evolution indicates that protoplasm and the animal can react in one of two ways; the first of these ways, and probably at the outset of evolution the only way, was for the animal to react to and with its surroundings. In the very early stages of life on the earth the temperature of living organisms was the same or nearly the same as that of the surrounding medium; similarly the fluids of the body originally possessed the same specific gravity as that of the surrounding fluid, and if, as we believe, life originated in the sea these early animals were exposed to an almost definite and constant salinity and to only slight changes of temperature and gas content, while owing to the permeability of the outer wall or ectoderm any changes in the surrounding medium were rapidly compensated by changes in the animal itself. But as evolution progressed, we find that this adaptability was given up and the animal began to react *against* its environment or perhaps one should say to insulate itself against environmental changes. Attention to this type of evolutionary process has been drawn recently by Wardlaw¹. As he points out, if the environment becomes too dry, the animal will surround itself with an impermeable wall and will encyst. At a later stage with the formation of a body, the body fluids at first possessed the salinity of the medium in which the animal lived, namely, that of the sea in which they originated, and doubtless fluctuated in accordance with the slight variations in the external conditions, but with the development of an ectoderm, that prevented the diffusion of the body salts into the surrounding medium, any subsequent change in the condition of the outer medium was without effect. The osmotic pressure of the body fluids such as the blood is in lower animals the same or very nearly the same is that of the surrounding medium. In Elasmobranchs the osmotic pressure of the two fluids is practically identical. In the Teleosts we get, however, the commencement of a controlling mechanism, for in the Plaice the osmotic pressure of the sea-water may vary 74 per cent while the osmotic pressure of the blood varies by only 20 per cent whereas in the cod the osmotic pressure of the sea may vary in different localities by 69 per cent but that of the cod's blood only by 3 per cent. One result of this stabilisation of the characters of the body fluids was to render it possible for marine animals to migrate into fresh water. Still later came the power of preventing

¹ Wardlaw, H. S. Halero, 1930. "Some Aspects of the Adaptation of Living Organisms to their Environment." Presidential Address, *Proc. Linn. Soc. N.S. Wales*, Vol. iv. P. I, p. viii.

the outer surface from drying up and the ability to absorb oxygen from the air, and in consequence animals were able to leave a watery medium and take to dry land.

This land migration was not limited to any one group of the animal kingdom. It has taken place independently in at least three of the great groups or Phyla. In the Mollusca the Pelecypoda have been able to invade fresh water, but up to the present time have not succeeded in populating the land. The Gastropoda, on the other hand, have been able to do so, and we now find numerous representatives that pass their whole existence out of water and are able to protect themselves in time of drought by closing the opening of their shell. The Cephalopoda, which are regarded as being the most highly evolved of the Mollusca, have throughout maintained their marine habitat. Again in the Arthropoda a number of Crustacea have taken to fresh water and some even to a terrestrial existence, though most still have to return to water for breeding purposes; the second and third great classes, the Insecta and Arachnida, are nearly all terrestrial and breathe air, though here again some have to pass through their early stages in water. It is in the Vertebrata that the greatest and most complete change of habitat has taken place. In the lowest class the fish are still essentially aquatic, though a few have developed accessory respiratory organs that enable them to breathe air. The Amphibia, as their name implies, frequent both a watery and a dry habitat, though here again their early life-stages are passed in water. The Reptiles, Birds, and Mammals are essentially land dwellers, though a few have again returned to an aquatic habitat.

Finally we get the stabilisation of the temperature of the body in both the Birds and Mammals, or the condition known as "Homiothermy"; formerly the body temperature varied with that of the outer air or water but its stabilisation in the warm-blooded animals not only rendered them comparatively impervious to the changes of the outer medium but, being stabilised at a moderately high temperature, enabled them to perform all the functions of the body at a much more rapid rate than could be done in animals whose temperature not only fluctuated but was frequently considerably lowered in conformity with that of the outer air or water. They thus have a distinct advantage over the cold-blooded animals. In this connection it is interesting to note that the mechanism of heat control is not so efficient in the lower mammals, Monotremes and Marsupials, as it is in the higher forms, and also is not so efficient in the young of these higher forms as it is in the adult; in *Echidna* a variation in the temperature¹ of 30° C results in a change of 10° C in the body temperature. In some of the higher vertebrates the warm-blooded condition is, however, not permanent, but is replaced by a cold-blooded state of "poikilothermy" during hibernation.

In the highest group of animals the Vertebrates and even in some of the Invertebrates this tendency on the part of the animal to cut itself off from its external surroundings has been carried even

¹ Pearse and Hall, 1928. *Homiothermism*, p. 91, New York.

further and has been supplemented by various devices that especially protect the individual in the very early stages of its development. In the lowest organisms eggs were and are laid in water and possess only a thin and delicate membrane around them, so that they are directly affected by changes in the external surroundings. Exposure to air would cause their drying up and the consequent death of the embryo, while changes in temperature would alter the rate or character of development. Then came the stage when the eggs were surrounded by a thicker covering, chitinous in some cases or with a lime shell in others. Such a shell prevents evaporation, so that the eggs can now be laid on land and development be expedited by the effect of the sun's rays, while the calcareous shell still further serves to protect the embryo from such influences as ultraviolet rays². Finally, animals tend to become viviparous and development occurs *in utero*, where the embryo is maintained in equable surroundings, completely protected from changes in temperature, salinity or other changes in the external conditions, since those of the parent remain constant. These changes, however, did not take place simultaneously with the alteration of the habit of the parent but followed, usually, at a later period, though in some cases it has taken place in animals that still inhabit their old ancestral environment, the sea. In the Elasmobranch fishes, for instance, the eggs are usually enclosed in tough chitinous egg-capsules, but in a few cases the process of intra-uterine gestation has been attained. In the Amphibia, while the lower forms still respire by gills, the higher are able to breathe air when adult, but they nearly all still lay their eggs, surrounded by a thin capsule and enclosed in a gelatinous matrix, in water, though some, such as the Java tree-frog, lay their eggs in a nest made of a rolled leaf. The Reptiles, however, acquired the method of enclosing their eggs in a thick chitinous shell, and were thus able to deposit them on land; and in certain cases the chitin of the shell is still further strengthened by the addition of calcium salts. The Birds enclose their eggs in a shell impregnated with calcium carbonate and have adopted the process of incubation, thus protecting the developing offspring from variations in temperature, and in all these cases, in addition to this provision of a protecting shell, the egg is supplied with a large amount of nutrient material or yolk, that enables the developing young to pass a considerable time within this protection and to reach a comparatively advanced stage of development before it has to become exposed to the varying character of the external surroundings. Finally, the Mammals have evolved the method of intra-uterine gestation, though here again the process was somewhat delayed, for the most primitive mammals, the Monotremata, still lay eggs, while in the Marsupials intra-uterine gestation is extremely short, the young embryos being transferred to the Marsupial pouch. The result of this is that there has throughout been a steadily progressive protection of the developing embryo from its external surroundings, so that environmental

² Hinrechs, Marie A., 1927. "Modification of development on the basis of differential susceptibilities to radiation." *Journ. Exper. Zool.*, Vol. xlvii, p. 309.

changes can no longer reach the embryo at that stage of its existence in which it is most, if not only, susceptible to such influences.

In a similar manner the introduction into the body of any substance is, if the introduction does not prove fatal, immediately counteracted by the production in the body of a substance that can neutralise the effect of the foreign materials; thus the introduction of an acid causes the production of an alkali, a toxin is met by the production of an anti-toxin, etc. In a number of cases, if not in all, the body overdoes the process, so that not only is the toxin neutralised but a superfluity of the anti-toxin is produced so that subsequent poisoning by the same toxin becomes more difficult or impossible, and this effect appears in some degree to be transmitted to the offspring.

It thus appears that throughout the later stages of evolution the animal has been steadily cutting off both itself and its offspring from its external surroundings and thus has equally throughout its whole life been cutting itself off from just those influences that in times past were responsible for the origin and gradual development of new forms and higher races. Wardlaw¹ concludes his address as follows: "We have in man, then, the most perfect adaptation to environment shown by any form of life. So great is his power of modifying his surroundings, and so rapidly is this power increasing that it would seem that further adaptation of his physical structures has become unnecessary." I would, on the other hand, be inclined to postulate that man has, or in the very near future will have, rendered himself so independent of his environment that this will no longer be able to affect his physical characters and that if there is to be any further evolution, this must be the result of his own mental processes.

¹ Wardlaw, H. S. Halero, 1930. "Some Aspects of the Adaptation of Living Organisms to their Environment." Presidential Address, *Proc. Linn. Soc. N.S. Wales*, Vol. Iv, Pt. I, p. viii.

ON A SMALL COLLECTION OF FISH FROM THE STREAMS IN THE
BILLIGIRIRANGAN HILLS (S. INDIA).

BY

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India.)

This note deals with a small collection of fish made by Mr. R. C. Morris in the various streams in the Billigirirangan Hills on the Mysore-Coimbatore border in South India at altitudes varying from 2,500 to 5,000 feet. The collection was made at the request of Dr. S. L. Hora through the courtesy of the Bombay Natural History Society and recently sent to the Zoological Survey of India for identification. I am thankful to Dr. Hora for the opportunity of studying these fishes.

The collection comprises eight different species belonging to the families Cobitidae, Cyprinidae and Ophicephalidae. All the species are known to occur in South India, and, except for a few on which notes are given below, do not call for special remarks. Mention must, however, be made of the excellent state of preservation of the material as a result of which the natural colouration of the different species is admirably preserved.

The details of localities, Kanarese local names, etc., are quoted *verbatim* from the original notes of Mr. Morris. The local names, however, are not meant to be absolutely correct, for, the collector himself remarked that he "cannot vouch for the correctness of the names."

Lepidocephalichthys thermalis (Cuv. et Val.).

1846. *Cobitis thermalis*, Cuvier et Valenciennes, *Nat. Hist. Poisson*, XVIII, p. 78.
1878. *Lepidocephalichthys thermalis*, Day, *Fish. India*, p. 610, pl. lv. fig. 3.
1927. *Lepidocephalichthys thermallis*, Rao & Seshachar, *Half-yearly Journ. Mysore Univ.*, I, No. 2, p. 10.

The height of the body is contained from 6 to 6½ times in the length of the body excluding the caudal fin. The origin of the ventrals is vertically below the first or the second branched ray of the dorsal fin.

The upper portion of the body is clouded with irregular black spots and blotches. In fairly grown-up specimens there are from 9 to 10 blackish bands along the back. Along the lateral line, there is a series of squarish black marks. The lower portion of the body is devoid of pigmentation. The fins, except the dorsal and the caudal, are diaphanous. Both the dorsal and the caudal fins have from 4 to 5 black curved bands. In some cases, these bands are broken up into irregular dots. A deep black spot at the base of the upper lobe of the caudal fin is present in all the specimens.

The species is known to inhabit the bottom mud or sand of rivers and ponds where it usually lies buried. Sundara Raj¹ has observed how this fish dives into the sand at the bottom of an aquarium. He further remarked that the "branchial respiration appears to be insufficient in this loach. In an aquarium, it grows restless at various intervals and rises to the surface to take air, which is apparently swallowed, consequently it lives for a long time out of water."

¹ Sundara Raj, B.—"Notes on Fresh-water Fish of Madras." *Rec. Ind. Mus.*, XII, pp. 261-262, (1916).

Nine specimens varying from 30 to 45 mm. in length were collected. The species is "found in all streams, in evergreen sholas and deciduous jungle and bamboo scrub below all elevations."

"Murralli" is the local Kanarese name of this loach.

Nemachilus striatus Day.

1867. *Nemachilus striatus*, Day, *Proc. Zool. Soc. London*, p. 347.

1878. *Nemachilus striatus*, Day, *Fish. India*, p. 617, pl. cliii, fig. 8.

This species was originally described by Day from Wynaad at 3,000 ft. elevation, but his description of the species is so inadequate, and the Indian species of the genus *Nemachilus* are in such a state of confusion at present that it is difficult to be certain about the specific identity of this fish. As Dr. S. L. Hora is already tackling the problem with a view to definitely define the specific limits and characters of the different species, I refrain from giving a detailed description of *N. striatus*, but provisionally refer the South Indian specimens to this species.

There are 10 to 12 vertical black bands along the sides. The dorsal fin is of an orange colour with two black bands. The characteristic black band at the base of the caudal fin is present in all the specimens.

The fish is represented in the collection by three specimens varying from 32 to 37 mm. in length. It is "found in all streams at eastern foot of hills (elev. 3,000 ft.), place—Mavatur, name of stream—Bellaji Halla. Stream heavily shaded."

The Kanarese call this loach "Kull-koorchi".

Nemachilus evezardi Day.

1878. *Nemachilus Evezardi*, Day, *Fish. India*, p. 613, pl. cliii, fig. 11.

1927. *Nemachilus evezardi*, Rao & Seshachar, *Half-yearly Journ. Mysore Univ.*, 1, No. 2, p. 11.

The length of the head is contained from 5 to $5\frac{1}{2}$ and the height of the body from 6 to $6\frac{3}{4}$ in the length of the body excluding the caudal fin. The eyes are small and are about two diameters from the tip of the snout. The width of the inter-orbital space is almost equal to the length of the snout. The pectoral fins are shorter than the head. The nasal barbels are longer than the diameter of the orbit and almost reach the anterior fourth of the eyes.

The colouration is a faint olivaceous green with a number of vertical black bars and blotches irregularly distributed.

The species is represented in the collection by six well-preserved specimens varying from 35 to 42 mm. in length. They are "found in rocky streams at eastern foot of hills (elev. 3,000 ft.), place—Mavatur, name of stream—Bellaji Halla. Stream heavily shaded."

The Kanarese do not apparently distinguish this species from *N. striatus* as both the species are locally known as "Kull-koorchi".

Garra sp.

There is a single specimen about 30 mm. long which appears to agree in all essential characters with *G. lamta* (Ham. Buch.), but since all immature forms of *Garra* show a wide range of variability in respect to specific characters, I refrain from referring it to any definite species.

The specimen was found with the two species of *Nemachilus* referred to above and collected in the "rocky stream at eastern foot of hills (elev. 3,000 ft.) place—Mavatur, name of stream—Bellaji Halla. Stream heavily shaded."

Barbus dorsalis (Jerdon).

1849. *Systomus dorsalis*, Jerdon, *Madras Journ. Lit. & Sci.*, XV, p. 314.

1878. *Barbus dorsalis*, Day, *Fish. India*, p. 573, pl. cxlii, fig. 2.

1916. *Barbus dorsalis*, Sundara Raj, *Rec. Ind. Mus.*, XII, p. 255.

The species is represented in the collection by a single young specimen about 45 mm. long excluding the caudal fin. The dorsal fin is inserted slightly in

advance of the ventrals and is situated nearer to the tip of the snout than to the base of the caudal fin. There are two prominent black spots, one each at the base of the dorsal and caudal fins. These spots are often absent in adult individuals. The upper portion of the body is dusky, and the bases of the scales are blackish. The belly is yellowish white.

The species is common "in all small streams (elev. 3,000 to 5,000 ft.) in shola, deciduous and scrub jungles."

"*Kull-kooni*" is the local Kanarese name of this fish.

***Rasbora daniconius* (Ham. Buch.).**

1822. *Cyprinus daniconius* & *anjana*, Hamilton Buchanan, *Fish. Ganges*, pp. 327-329, 391, pl. xv, fig. 89.

1878. *Rasbora daniconius*, Day, *Fish. India*, p. 584, pl. cxlvi, fig. 2.

1929. *Rasbora daniconius*, Prashad & Mukerji, *Rec. Ind. Mus.* XXXI, p. 203.

The diameter of the eyes is contained from 4 to $4\frac{1}{2}$ times in the length of the head; they are $1\frac{1}{2}$ to $1\frac{3}{4}$ diameters apart. The snout is almost equal to or slightly longer than the diameter of the eyes.

The dorsum is dusky. There is a black streak running along the median dorsal line from occiput to the insertion of the caudal fin. A very prominent transverse broad black band runs along the middle of the body from the snout to the base of the caudal fin. In some specimens, the scales of the upper portion of the body have dark edges. The fins are diaphanous.

The species is represented in the collection by eight specimens, the largest being 85 mm. in length. It is "found in a big stream at Punjur (western foot of hills) elev. 2500 ft. Partially shaded, rocky and sandy."

"*Sessillu*" is the local Kanarese name of the species.

***Barilius gatensis* (Cuv. et Val.).**

1844. *Leuciscus gatensis*, Cuvier & Valenciennes, *Hist. Nat. Poisson*, XVII, p. 309, pl. 503.

1878. *Barilius gatensis*, Day, *Fish. India*, p. 592, pl. cxlix, fig. 2.

1931. *Barilius gatensis*, Mukerji, *Journ. Bombay. Nat. Hist. Soc.*, XXXV, p. 169.

Very thin maxillary barbels are present in all the specimens. The number of vertical black bars along the sides varies from 9 to 13. The dorsal fin has a triangular white outer area. The anal fin has a dark base. A bright pink band and a white outer streak run parallel to it. The pectorals and ventrals have similar pink bands. The cheek and the belly are of a light pink colour.

Seven well-preserved specimens were collected. The largest of the series is 88 mm. long. The species was found in (i) "rocky stream at eastern foot of hills (elev. 3,000 ft.), place—Marealut, name of stream—Bellaji Halla. Stream heavily shaded", and (ii) "in a big stream at Punjur (western foot of hills), elev. 2,500 ft. Partially shaded, rocky and sandy".

"*Genday*" is the local Kanarese name of this fish.

***Ophiocephalus gachua* (Ham. Buch.).**

1822. *Ophiocephalus gachua*, Hamilton Buchanan, *Fish. Ganges*, pp. 68, 367, pl. xxi, fig. 21.

1878. *Ophiocephalus gachua*, Day, *Fish. India*, p. 367.

1929. *Ophiocephalus gachua*, Prashad & Mukerji, *Rec. Ind. Mus.*, XXXI, p. 215.

Two half-grown specimens were "found in a big stream at Punjur (western foot of hills) elev. 2,500 ft. Partially shaded, rocky and sandy."

"*Kworamin*" is the local Kanarese name of the species.

NOTES ON INDIAN HAWKMOTHS.

BY

LT.-COL. F. B. SCOTT, I.A., F.E.S.

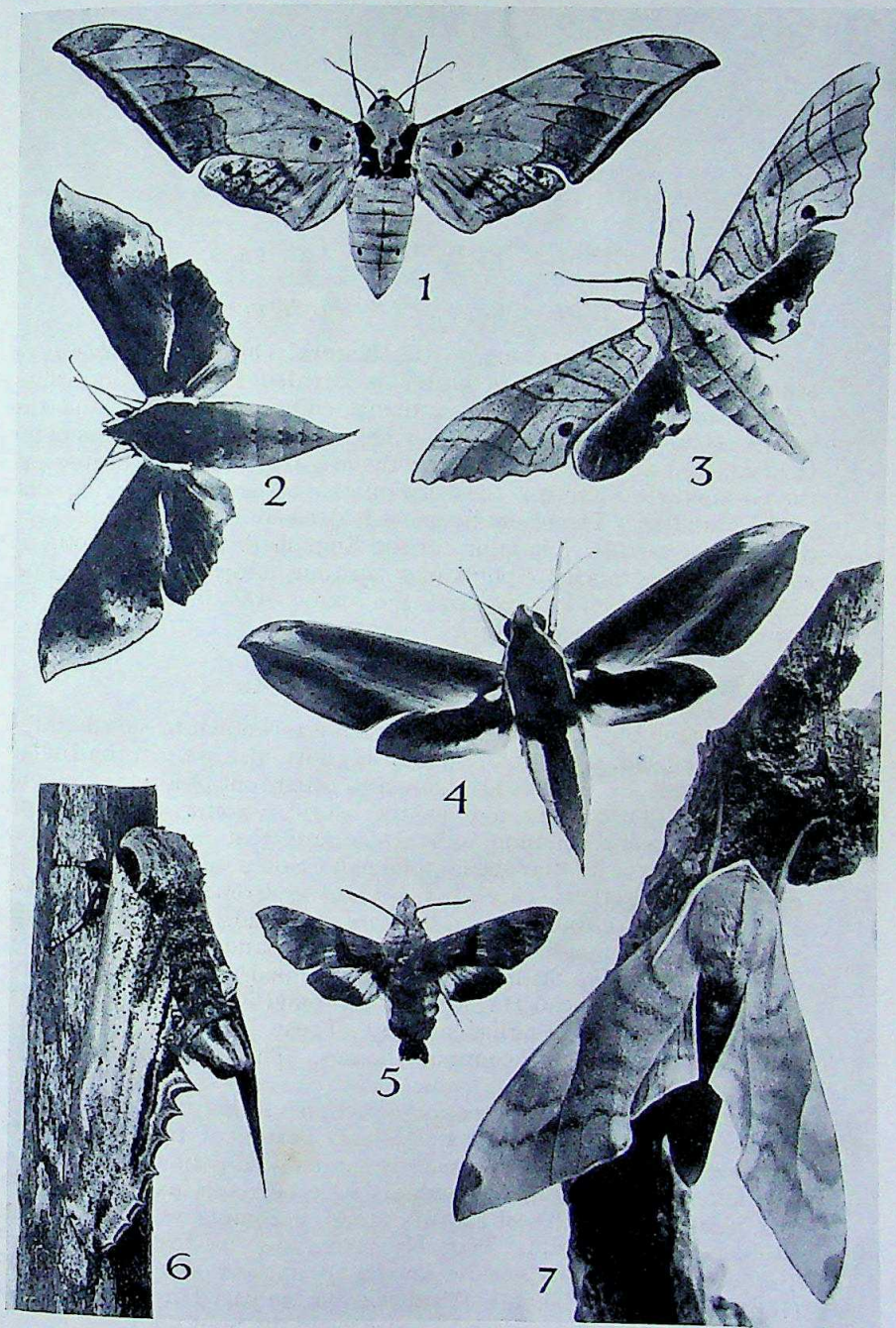
(With 3 plates and 9 text-figures.)

The Hawkmoths belong to the Natural Order *Lepidoptera*, or scale-winged insects. This Order is divided into the Butterflies (*Rhopalocera*), which have the antennæ ending in a club, and the moths (*Heterocera*), which have the antennæ of various forms other than clubbed at the ends. The moths are divided into Groups, and the Groups into Families, the Hawkmoths or *Sphingidæ* being one of the Families. The scientific name is derived from 'sphinx', the designation used by Réaumur for the English Privet Hawkmoth, on account of the fancied Sphinx-like attitude adopted by the caterpillar when it is alarmed, and the name was later adopted by Linnæus for the whole Family.

DISTRIBUTION AND FOOD-PLANTS.

There are but 17 species of Hawkmoths known to occur in the British Isles, and some of them are only rare visitors. In the Indian Empire about 180 species are known to occur, out of a total of about 850 species known throughout the world. Some of the Indian species are very common, others so rare that only one or two individuals have so far been obtained. Some of the species are widely spread, others very local in their occurrence. A few of the species which are found in England are found also in India. These are the Convolvulus, Broad-bordered Bee, Oleander, Humming-bird, Spurge, Bedstraw, Striped and Silver-striped Hawkmoths. Two species of Death's-head Hawkmoths are found in India, but they are not the same as the English species. These are the only species which have been given 'common' names. The rest are known only by their scientific names.

Certain parts of India are more rich in species than other parts. Areas with a heavy rainfall and a large variety of trees and plants produce the largest number, and dry areas with poor vegetation the smallest number, though individuals of certain species may occur in vast numbers in both wet and dry areas, becoming serious pests on crops and other plants. Probably many new species remain to be discovered, but of those now known 58 species occur in the west Himalaya (west of Nepal), 128 species in the east Himalaya (east of Nepal, and including Assam), 73 species in the South of India and 40 in Burma. Many more species must occur in Burma, but very little collecting has been done there. The North Kanara district of Southern India is very rich, having over 45 species in an area of



INDIAN HAWKMOTHS.

1. *Oxyambulyx sericeipennis*, Butl. ♀
2. *Rhagastis albomarginatus*, Rothsc.
3. *Marumba sperchius*, Ménétries. ♂
4. *Theretra nessus*, Drury.
5. *Rhopalopsyche nycteris*, Kollar. One of the Humming-Bird Hawkmoths.
6. *Langia zenzeroides*, Moore.
7. *Clanis phalaris*, Huebner

3,600 sq. miles. The distribution of the species overlaps, some of them occurring in more than one of the areas mentioned. The plains area of Northern India has no special Hawkmoth fauna of its own, but receives contributions from the surrounding areas. The information on this subject is very scanty and it is worth recording the locality where any Hawkmoth is obtained.

The distribution of the moths is dependent to a great extent on that of the food-plants on which the caterpillars feed, though the moths are such fast fliers that they may be found a long way away from the nearest food-plant. Some species feed on a wide range of food-plants, others confine themselves to one or more. The food-plant on which any Hawkmoth caterpillar is found feeding should also be recorded. Plants belonging to the botanical Order *Rubiaceæ*, to which *Randia*, *Gardenia*, Madder, Bedstraw and other shrubs, herbs and creepers belong, is the most popular food-plant, about 30 species feeding on plants of this Order. Vines (Grape vine, Virginia creeper, *Leca*) and Arums (Garden arum, Caladium, Cuckoo-pint, Snake plant) are the next most popular, with about 16 species each. Leguminous trees and plants (Indian Beech, Shisham, Indian Laburnum, Shiras, Gram, Pulse) come next, followed by Balsams and Spurge. Altogether about 50 Orders of plants are represented in the list of Hawkmoth food-plants known up to the present, ranging from the largest trees to the most insignificant herbs, and including even grasses.

THE HAWKMOTH.

I have often heard the questions asked 'What is a Hawkmoth? How can one tell a Hawkmoth from any other kind of moth?'

In order to do so with certainty, it is necessary to make a minute examination of the veins of the wings and of the organs of the body, but for all practical purposes something more simple will suffice. Hawkmoths can usually be recognised by their characteristic appearance and habits. The fore-wing is long, narrow and sharply pointed; the hind-wing short and rounded; the eyes large; the chest or *thorax* heavy; the body or abdomen shaped like a cigar, or like the pointed end of a cigar. This last character is sometimes obscured by lateral tufts of hairs giving the impression of a broad tail, such as occurs in the Humming-bird Hawkmoths and a few other genera (Plate I, fig. 5); but the other characters are present, and also the clean-cut, high-bred appearance common to all Hawkmoths (Plate I). Finally, if when strolling in your garden in the evening you notice a moth, poised almost motionless except for its rapidly vibrating wings in front of a flower, suddenly darting away and as suddenly re-appearing, and never settling, you may be sure you are observing a Hawkmoth, since no other kind of moth is known to feed in this manner. If you look more closely you will see that when poised before the flower, the moth unrolls a long tongue or proboscis, and probes the flower for honey. All Hawkmoths which have been seen feeding, with the single exception of the Death's-head Hawkmoths, have this habit of feeding when on the wing. The Death's-head moths are known to enter bee-hives to steal the honey. The vibration of the wings makes a deep humming note

when the moth is flying, and some species produce a similar note when at rest, if they are disturbed.

The Hawkmoth caterpillar can be recognised by the hard, chitinous horn on segment 12, though a few caterpillars of other families have a somewhat similar, but soft fleshy horn.

THE EGG.

The eggs of Hawkmoths are round or oval, and are most commonly of a green colour with a translucent appearance, like a tiny, green grape, but they may be almost white or pale yellow, or more rarely brown or orange, in different species. The egg-shell is either smooth and shiny, or dull, and no sculpturing is visible to the naked eye. The eggs of different species vary a good deal in size, the smallest being about 1 mm. in length, and the largest about 3 mm. The average size is about that of a pin's head.

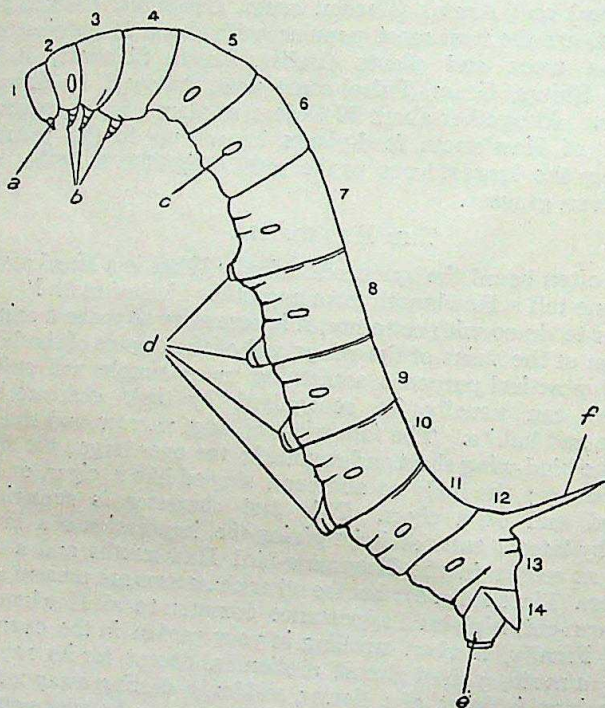
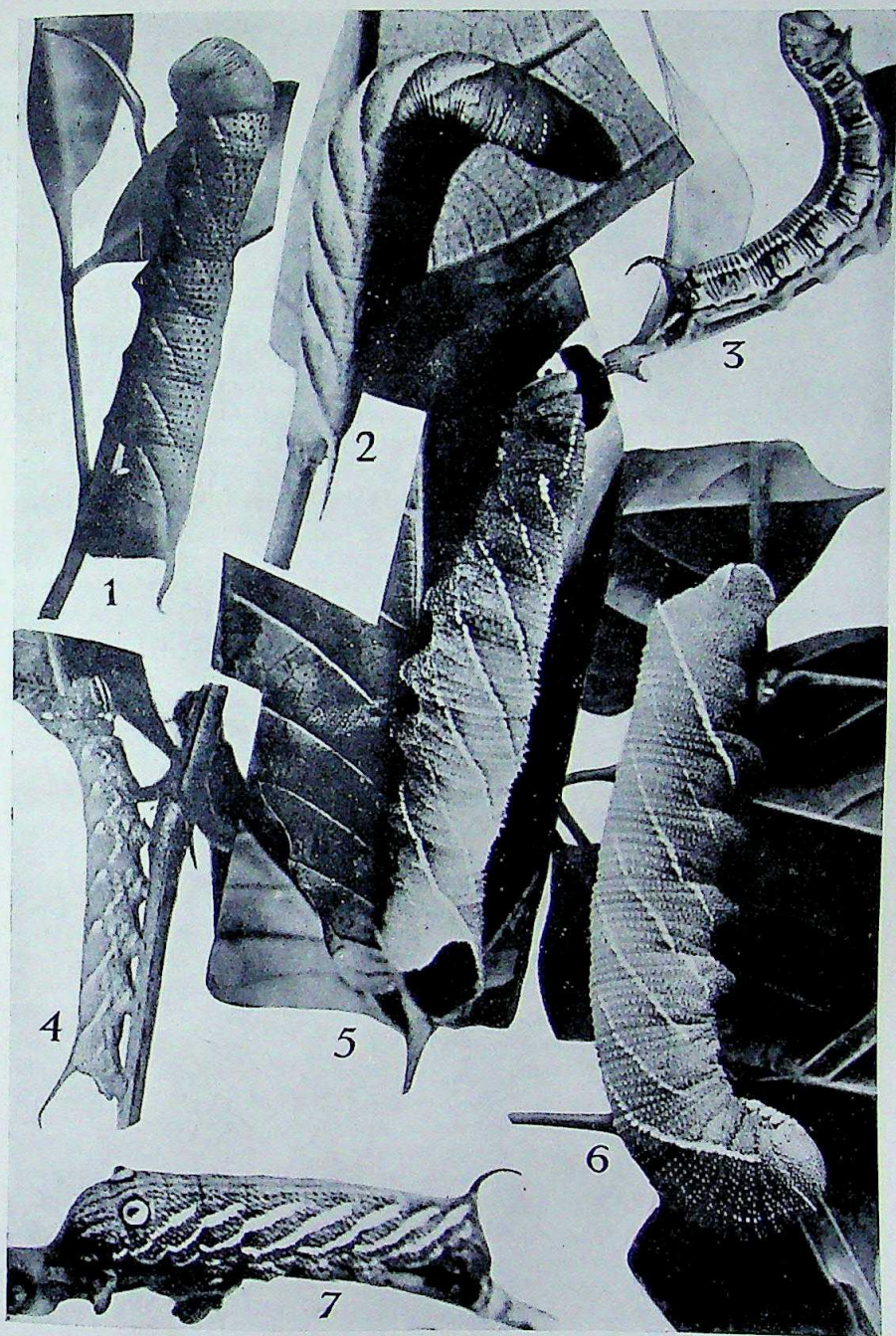


Fig. 1. A Hawkmoth caterpillar, showing segments. 1 (the head) to 14 (the anal segment).
a, the antenna; b, the true legs; c, a spiracle, or breathing hole; d, the prolegs; e, the anal clasper; f, the horn.

THE CATERPILLAR OR LARVA (FIG. 1).

The Hawkmoth caterpillar, like other insects, has a head and thirteen other segments. There are different ways of numbering these segments, but we have adopted the method shown in figure 1,



INDIAN HAWKMOTHS.

1. *Acherontia styx*, Westw. One of the Death's-Head Hawkmoths. Note the twice curved horn and oblique stripes.
2. *Psilogramma menephron*, Cramer. Note the wart-like tubercles and oblique stripes.
3. *Cephonodes hylas*, Linn.; in Sphinx-like attitude. Note the tubercles on segment 2 and horn, and the spiracles.
4. *Pseudodolbina* fo, Wlk. Note the wart-like tubercles and oblique stripes.
5. *Marumba sperchius*, Ménétries. Note the tubercles all over, and the oblique stripes.
6. *Clanis phalaris*, Huebner. Note the very small horn, tubercles and oblique stripes.
7. *Rhagastis albomarginatus*, Rothc. Note the conical scoli and oblique stripes.

counting the head as segment 1, the segment next to the head as segment 2, and so on. The body of the caterpillar is usually round in section, and is more or less cylindrical in some species (Pl. II, figs. 1 to 6), and in other species increases rapidly in diameter from the head to segment 5, and then becomes cylindrical to segment 12 (Pl. II, fig. 7; Pl. III, figs. 1, 2). Segment 2, 3 and 4 each bear a pair of *true legs*. These are hard and shiny, have three joints and a claw for gripping at the tip (fig. 1. b). They are called 'true legs' as they occur on the same segments as they do in the moth. Segments 5 and 6 are without legs. Segments 7 to 10 each have a pair of *pro-legs* or false legs (fig. 1 d). These legs are not present at all in the moth. They are fleshy and soft, with a circular pad set all round with curved hooklets, which enable the caterpillar to obtain a firm grip on any surface. Segments 11 to 13 are again without legs, but segment 14 bears the *anal claspers* (fig. 1 e). The anal claspers are similar to the pro-legs but have a still larger gripping surface. So tightly does the caterpillar cling to any rough surface that if it is pulled away, the ends of the pro-legs and claspers are sometimes torn off. Segments 2 and 5 to 12 each have a pair of *spiracles* or breathing holes (fig. 1 c). These, with the air-tubes or *tracheae* which start from them and spread through the tissues of the body, supplying them with oxygen, take the place of the breathing apparatus in mammals, birds and reptiles. The spiracles are oval in shape and have a central slit or opening down the long axis. They are of different colours in different species. Those on segments 2 and 5 to 11 are placed vertically in about the middle of the segments, and that on segment 12 obliquely. Segment 12 bears the horn which is so characteristic of Hawkmoth caterpillars (fig. 1 f). Segment 13 is narrow and rather difficult to make out sometimes, as it is wedged between segments 12 and 14. Just above the anal claspers on

segment 14 is the *anal flap*, a fleshy triangular flap which covers the anus. The head (fig. 2) is made up of separate chitinous plates fused together into one piece. The front part of the head is called the *face*. This is made up of a triangular plate called the *clypeus* (fig. 2, a) and the frontal portion of the two lobes (fig. 2, b). The sides of the head are called the *cheeks*. Projecting from the lower part of each cheek are the *antennae* (fig. 1, a and fig. 2, c). These have three joints, and two bristles, a long and a short one, at the tips of the end joint. The bases fit into sockets in the cheek, and the whole organ is moveable. The function of the antennae is not known with

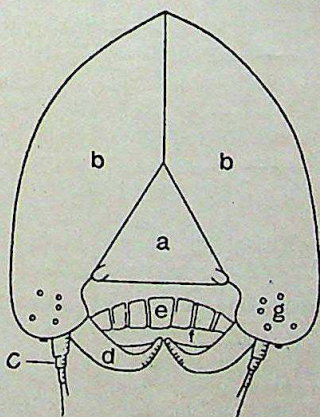


Fig. 2. Head of a Hawkmoth Caterpillar.

certainly. Between the antennae are the powerful jaws or *mandibles* (fig. 2, d) with their bases also set in sockets in the cheeks. They are wedge-shaped, curved near the tips, with bevelled edges working

against each other sideways, and are used to cut pieces from the leaf when feeding. Behind the mandibles are mouth-parts called the *labrum* (fig. 2 e) and the *ligula* (fig. 2 f) which come into play when the caterpillar is feeding. Above the base of each antenna is a group of five eyes directed forwards, and a sixth eye is near the base of the antenna but directed downwards (fig. 2 g). These are very small, hardly visible to the naked eye, but under a magnifying glass appear as circular, convex, black dots. It is doubtful if the caterpillar can see more than a few inches with these eyes. Behind and below the mandibles is a small cone with a perforated tip, which is the *spinneret* from which a thread of silk can be spun at will.

PUPA OR CHRYSALIS (fig. 3, 4 and 5).

The Hawkmoth pupa has a shell or casing of hard chitinous material, inside which the moth forms. The pupa has the same number of segments as the caterpillar. The head (segment 1), the thorax (segments 2 to 4) and segments 5 to 8 of the abdomen are all fused together so that they are immovable, but the remaining segments of the abdomen are jointed and moveable (fig. 3). The

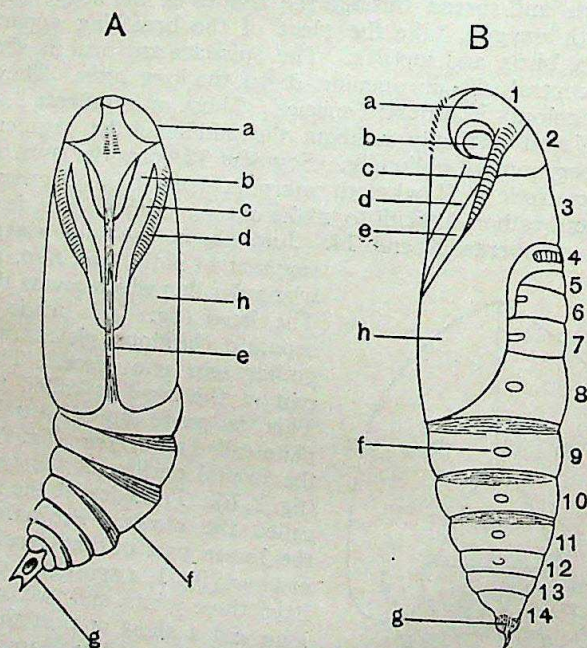


Fig. 3. Pupa or Chrysalis of a Hawkmoth.

- A. Ventral view; a, the head; b, foreleg; c, midleg; d, antenna; e, tongue; f, a spiracle; g, cremaster; h, wings.
 B. Lateral view.—a, head; b, eye; c, antenna; d, foreleg; e, midleg; f, spiracle; g, cremaster; h, wings.

head is usually round and blunt, the abdomen pointed as in the moth, the body being thickest in the middle. The case is so moulded that the position of the head, eye, tongue, fore and middle legs, the antennae, folded-up wings and the body of the future moth can be seen (fig. 3). The tongue runs down the middle of the ventral surface, and may or may not reach the end of the wing-cases. On either side of it are the lower part of the fore legs, then the middle legs and then the antennae. The hind legs are concealed under the edge of the wing-cases, which start near the antennae and reach about half way down the ventral surface of the pupa. At the end of segment 14 is the *cremaster* (fig. 3, g). This is an organ of hard chitinous substance, which is either triangular or spike-shaped, and usually branches into two points. These points may again divide into two, and there may be one or more pairs of small hooks. The shape of the cremaster and the arrangement of the hooklets provide a valuable means of identifying different species in the pupal stage. The cremaster does not appear to perform any function except when provided with hooklets. When these are present they are used to fix the tip of the abdomen to a pad of silk woven by the caterpillar at the end of the cocoon. Spiracles are present on segments 2 and 5 to 12 as in the caterpillar, though that on segment 5 is concealed by the edge of the wing-case.

In some species of Hawkmoth the tongue is very long, and it cannot be accommodated in a pupal case shaped as in figure 3. It is then housed (to use a mechanical term) in a special hollow casing which projects in front of the head of the pupa (fig. 4). The Convol-

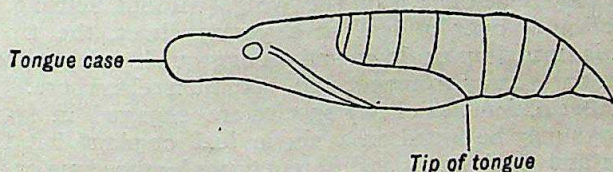


Fig. 4. Chrysalis of Hawkmoth with tongue case.

vulus Hawkmoth (and a few other species) has such an excessively long tongue that it cannot be accommodated even in this manner, and it is then housed in a *free tongue-case* (fig. 5). The tongue

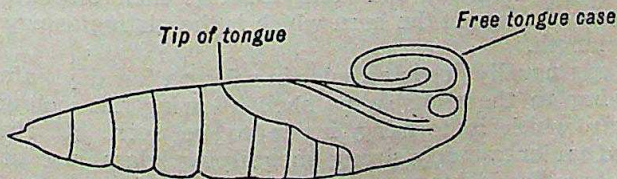


Fig. 5. Chrysalis of Hawkmoth with free tongue case.

starts from the front of the head, runs along the case to its bulbous end where it turns back on itself and re-joins the head casing, then

runs between the wing-cases to the end of the latter. This free tongue-case looks like the handle of a jug.

In colour the pupa is chestnut or dark-brown in the case of those species which pupate underground, and of various colours, with dark or pale dots, stripes or patches in the case of those which pupate on the surface. The surface of the pupal case may be smooth and shiny, or dull, and is sometimes shagreened or covered with small tubercles, and sculpturing is sometimes present on segment 4 or near the spiracles and head.

MOTH OR IMAGO

The general appearance of the Hawkmoth has been already described. Those who wish to study the structure are referred to Rothschild and Jordon's great work on the Hawkmoths, *The Revision of the Sphingidæ*, in *Novitate's Zoologica* Vol. IX, Supplement (1903).

LIFE HISTORY AND HABITS

The Hawkmoths, with very few exceptions, lay their eggs singly, usually on the undersides of the leaves of the food-plant or plants on which their caterpillars feed. Each egg is stuck firmly to the leaf or twig with some sort of gum secreted by the moth. The operation of egg laying has not been observed in natural conditions in the vast majority of Hawkmoths, as it is usually carried out after dark, but a few day-flying species have been seen laying their eggs, and they have done it on the wing, without settling. While poised delicately over a leaf or a young shoot, the tip of the abdomen is turned up or down and an egg quickly deposited. The moth then darts away to repeat the operation elsewhere. When a large number of females of any species are engaged in egg laying, several eggs may be found on a single leaf or plant but they are almost certainly laid singly at different times by the same or different females. Most butterflies, and a few moths also lay their eggs singly, but the eggs of butterflies can usually be distinguished from those of Hawkmoths by being of various shapes, and by the shells being sculptured into patterns visible to the naked eye. The eggs of some of the swallow-tail butterflies are very similar to Hawkmoth eggs, and one might be taken in by the resemblance until the young caterpillars hatch out. All doubt is then dispelled by the presence or absence of the horn which is the distinguishing mark of the Hawkmoth.

The egg usually becomes paler in colour a few days after being laid, owing to the transparent shell allowing the colour of the caterpillar which is forming inside to be seen. If the egg is examined under a fairly strong magnifying glass just before the young caterpillar is due to emerge, the head and some parts of the body may be made out.

The young caterpillar or *egg-caterpillar* comes out in 5 to 10 days after the egg is laid, the larger species usually taking a longer time to hatch than the smaller species. The egg-caterpillar eats a hole in

the side of the egg-shell, and makes its way out in a minute or so. Most commonly it is of a pale yellow colour, including the horn, but the horn soon becomes black. The body is covered with hairs which are visible to the naked eye in some species. The caterpillar eats more or less of the egg-shell for its first meal and after resting for a time along the midrib or a vein of the leaf, starts to eat the leaf itself. It often eats small holes in the middle of the leaf at first, and tackles it from the edge when it grows a bit bigger. After feeding for a few days the body becomes too big, not for its boots, but for its head and legs, which are unable to stretch like the skin of the body does. The caterpillar then settles down to change its skin and acquire a larger head. It lies motionless along a midrib or vein for some hours, and then the new larger head may be seen forming under the skin behind the old head. The old head is pushed forward till the skin breaks round the neck. Then by an undulating movement of the body the old skin is worked back, until, with a waggle of the claspers it is cast off, and the old head is also got rid of. Some species eat the cast-off skin. After resting for a time the caterpillar starts feeding again, and when the body becomes too large for the head it changes its skin again. In most species there are four such changes of skin before the caterpillar reaches the final or mature stage (each stage being called an *instar*), and there is some change of colouring or form or both at each moult. The ocelli or other markings gradually develop, and the shape of the body and of the horn may differ in each successive moult. The caterpillar feeds more and more voraciously as it nears maturity, then suddenly stops feeding and remains motionless for about 24 hours. During this period of rest it often becomes of a darker colour in preparation for its descent to the earth, green caterpillars assuming a pink or brown suffusion along the back, and dark-coloured caterpillars becoming still darker.

Suddenly leaving the food-plant the caterpillar begins to look for a suitable place to pupate. Those species which pupate underground get very agitated and hurry along the ground with a quick undulating motion, and if touched, lash their bodies wildly from side to side. Their pro-legs and claspers gradually lose their power of gripping, and the caterpillar falls over lumps of earth and other obstructions in its anxiety to get safely underground. When it finds a soft place, it immediately starts digging with its head, and very soon disappears under the surface. It may dig down to a depth of 6 or 8 inches, and there makes a large oval cell in which it turns to a pupa.

The species which pupate on the surface (these are the larger number) do not have to travel so far to find a suitable spot, and are more leisurely in their movements. They crawl under dead leaves and vegetation, and make a rough cocoon by joining leaves, earth and rubbish together with a few strands of silk from the spinneret.

The change to a pupa takes place from two to ten days after going underground or starting the cocoon, but in one or two species, may not take place for several months. The change to the pupa is not carried out in the same way as the moults in the caterpillar. When ready to pupate, the head of the caterpillar splits down the

front, and the head of the pupa is pushed through the slit. The skin of the caterpillar, with the head attached to it in two halves, is then worked back over the body of the pupa. The pupa is at first soft and shapeless, and the sheaths or cases which will later on contain the antennæ, legs, wings and tongue are separate from the body, but they soon fall into their final positions and become firmly fused to the body. The pupal case hardens and assumes its final form and colouring. After lying nearly motionless for a period of from a fortnight to several months, according to the species and the time of year and other factors, the pupal shell splits open along the dorsal line of the thorax, the head and tongue case breaking away together, and the moth emerges and dries its wings, and darts away to feed and find a mate. After mating, the male dies, the female lays her eggs to start a fresh brood and then she also dies.

This is a short outline of the life history of the Hawkmoth. There are many variations, some common to whole subfamilies or genera, others peculiar to certain species, but it is not possible to give more than a general account in these notes.

COLOUR AND MARKINGS.

When first hatched, the Hawkmoth caterpillar is usually some shade of pale yellow or yellow-green, and is without markings. In a few cases only the colour is brown or black. After feeding for a time the green colour of the food sometimes shows through the body, giving it a green tinge. In the second and third instars, that is, after the first and second changes of skin, the colour is usually green, and the oblique stripes and other markings begin to appear. Where the mature caterpillar has the eye-like markings called *ocelli*, these first show as round spots of a uniform colour, and develop with each change of skin till they reach their final form. In the greater number of species the colour remains green in the fourth and fifth instars (the fifth usually being the final instar before the caterpillar pupates), but there is in some cases a startling change in the fifth instar, the ground colour of the head and body changing from green to brown, black or purple. The oblique stripes and other markings may remain unchanged or may be greatly modified. Even in the case of those species in which the colour is normally green till maturity, individual caterpillars may assume this dark form of colouring in the final or in earlier instars, and in a few species there are three or more differently coloured forms. The various forms are so unlike each other in colour and sometimes in markings as well, that one would not believe them to be the same species, but the moths bred from the different forms are identical. There are other cases where the change to a dark form is not complete, certain individuals developing dark patches which do not cover the whole body. In the few cases where the egg-caterpillar is black, the colouring may remain black (or dark) throughout, or there may be both dark and green forms. The different cases may be summarised as follows, in the order of their occurrence in nature:—

(a) The caterpillar is always green in the earlier instars, later has both a green and a dark form, or three or more different forms.

- (b) The caterpillar is always green from birth to maturity.
- (c) The caterpillar is always green in the earlier instars, later has a green form with or without dark patches.
- (d) The caterpillar is always green until the last instar, always dark in the last instar.
- (e) The caterpillar is dark in the earlier instars and later has only a dark form, or both dark and green forms.

The occurrence of two or more differently coloured forms in the caterpillar, with no corresponding change in the moth, is very curious. It cannot be accounted for by any difference in food, since the different forms are found feeding on the same plants. The green form is usually the most common in nature, or at least the form most commonly found, but when specimens are bred from an early stage in a dark tin or box, a far larger proportion of them assume the dark form. This seems to show that absence of light is a factor in influencing the colouration. On the other hand, dark-coloured specimens are found in nature in the same situations as the green forms, both forms being exposed to the same amount of light. Also, where there is only a dark form at maturity, the dark, mature caterpillars are often found during day-light in the same situations as green forms of other species. I had a curious experience with caterpillars of the *Convolvulus Hawkmoth* at Sheikh Othman, near Aden. There were large numbers of them in the earlier green stages on a certain creeper, but no mature caterpillars could be found. Someone suggested keeping the small caterpillars in more or less natural conditions in a large box. On doing so it was found that all specimens turned to a dark form at maturity, and that during the day they left the food-plant and hid among dead leaves and even buried themselves in the earth to avoid the light. This experience does not lead us to any conclusion, since it may be argued either way—that the caterpillars hid themselves because they had assumed the dark form, or that they assumed the dark form because they had developed the habit of hiding during the day. Further evidence on this question is required to enable the problem to be solved.

In addition to the general colouring, Hawkmoth caterpillars have various markings, the most common style of markings being longitudinal stripes, oblique stripes and ocelli. Longitudinal stripes may be present in combination with either oblique stripes or ocelli, or all three types of markings may appear together. The longitudinal stripes may be present along the back (*dorsal*), high up on the side (*dorso-lateral*), through the spiracles (*spiracular*) or below the spiracles (*sub-spiracular*). The oblique stripes are usually seven in number, on segments 5 to 11: that on 11 extending upwards and backwards over segment 12 to the base of the horn. (Pl. II). The ocelli occur in one pair on segment 5, or two pairs on segments 5 and 6 or in seven pairs on segments 5 to 11. In one species there is an extra pair on segment 4. The ocelli are round or oval, and usually have a dark centre surrounded by a paler colour and then a dark ring (Pl. III, Figs. 1, 3, 5, 6). In some cases they are convex in section and shiny in appearance, and then the resem-

blance to a real eye is increased (Pl. II, Fig. 7). The ocelli usually lie on the dorso-lateral line, but in a few cases the spiracle on segment 5 is ringed with colour, so that it resembles an ocellus.

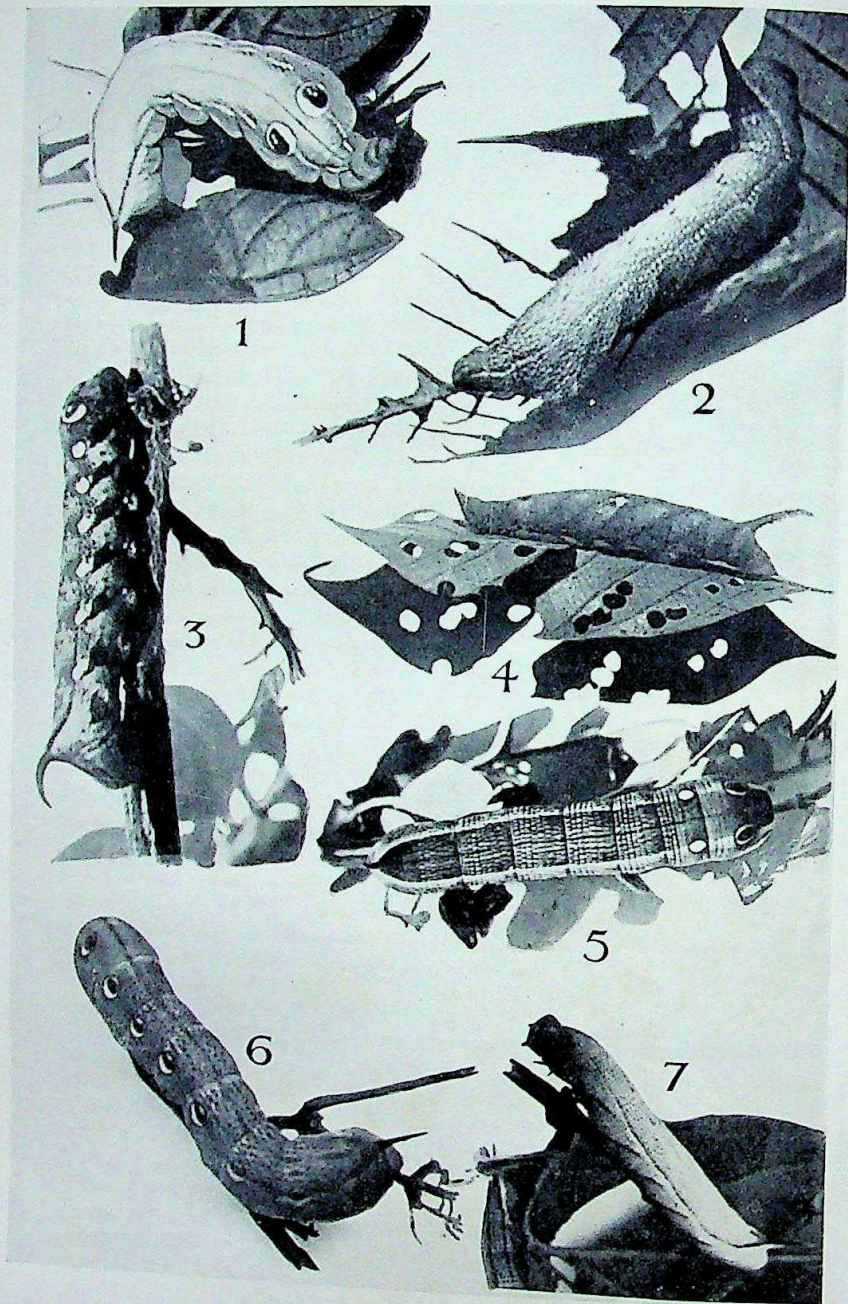
At each change of skin, the shape of the head, body and horn may change, as well as the colouring. In the egg-caterpillar the head is always round, and it may remain round to maturity, or it may become triangular or pointed in the second instar (Pl. III, Fig. 4). In a few cases the head of the egg-caterpillar is round, it then becomes triangular or pointed, and at maturity again becomes round. The body is nearly cylindrical at birth, and remains so to maturity in some species, while in other species the fourth and fifth segments become tumid or swollen. The horn of the egg-caterpillar is always straight, slightly tapering, and *bifid*, or with two points, and each point bears a hair or *seta*. The double point is usually lost in the later instars, but in some cases persists to maturity. The horn may remain straight, or it may become curved downwards, more rarely upwards, and in a few cases it is twice curved, first down and then up, as in the Death's-head Hawkmoths. The shape, thickness and relative length varies greatly in different species, and in some of the genus *Clanis* may be so small as to be overlooked (Plate II, Fig. 6).

In the egg-caterpillar the horn can be moved at will in a vertical plane and this limited power of movement is retained in a few species, where the horn is very thin up to maturity, but in most species all power of movement is lost in the later instars, and the function of the horn, if any, is unknown. In some Hawkmoth caterpillars from South America the horn is very long and whip-like and can be moved freely over the back of the caterpillar like the filaments of the Puss-moth caterpillar. In these species it may serve to drive away parasites, but it is not long or mobile enough to be of any use for his purpose in any Indian species.

The surface of the head, body and horn is usually dull, and either smooth or tuberculate. The tubercles may cover the whole surface, or may be present on certain parts only. Sometimes only the horn is tuberculate, or the tubercles may run along the back or along the line of the oblique stripes. In one species they have developed into long fleshy spines, and in others into wart-like prominences. Hairs are always present, but except for a few on the head, legs, pro-legs and anal flap, are too small to be seen without a lens. (Plates II and III).

MEANS OF DEFENCE AND ENEMIES.

The Hawkmoth caterpillar is a most defenceless creature. Having no long hairs or poisonous spines such as many other kinds of caterpillars have, it falls an easy victim to many other creatures. Its only hope of escaping from its enemies is to avoid detection, and for this purpose its habits and colouring are admirably adapted. It habitually lives on the underside of the leaves of the food-plant, and grasps the midrib or a vein with its pro-legs or claspers, its head directed towards the point of the leaf. When resting it is entirely hidden from above by the leaf, and when feeding only the head and



INDIAN HAWKMOTHS.

1. *Rhagastis confusa*, Rothsc. Note the large ocelli.
2. *Ampelophaga khasiana*, Rothsc. Note the tubercles and the dorso-lateral stripes.
3. *Theretra clotho*, Drury. ; dark form. Note the seven pairs of ocelli.
4. *Degmaptera mirabilis*, Rothsc. Note the pointed head and pointed horn.
5. *Hippotion celerio*, Linn. Note the two pairs of ocelli, dorsal and dorso-lateral stripes.
6. *Theretra alecto*, Linn. Note the seven pairs of ocelli.
7. *Macroglossum pyrrhosticta*, Butl. A Humming Bird.

one or more pairs of legs are visible. When young, the pale colouring matches that of the midrib, and later, when the green colour and the oblique side stripes have developed, the latter lie parallel to the side veins, and the whole creature appears to melt into the leaf. Some species have irregular spots which look like dead patches in the leaf. When once discovered and attacked, the caterpillar can only defend itself by raising the front part of the body and hitting side-

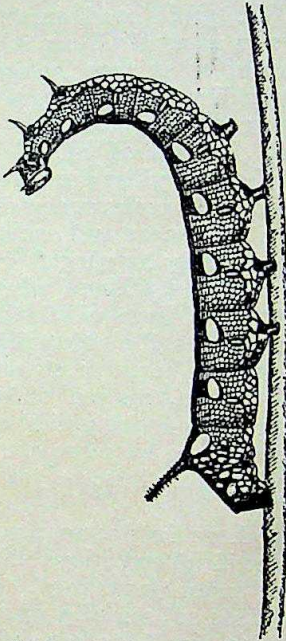


FIG. 6. Spurge Hawkmoth Caterpillar's attitude in defence.

ways with the head. The Death's-head caterpillars increase the effect by making a clicking noise with their jaws, and those of *Langia zenzeroides* and other species make a loud squeak at each stroke by expelling air forcibly through the spiracles. Those caterpillars which have ocelli draw in the head and anterior segments into segments 4 and 5, at the same time puffing out these two segments as to expand the ocelli to their full extent (Pl. III, Fig. 1). This gives them a somewhat snake-like appearance, and the effect is enhanced by their raising the fore-part of the body and waving it from side to side. The Spurge Hawkmoth caterpillars have a more effective means of defence. They live gregariously on the Spurge, a dozen or more perhaps on a plant. When disturbed, they throw back the head and fore-part of the body and eject drops of clear green fluid (fig. 6). The effect of their simultaneous action is most startling, and probably serves to drive away small enemies. Their striking appearance, lack of concealment and the poisonous nature of their food-plant point to their being unpalatable to birds.

The enemies of the Hawkmoth caterpillar are many and varied. The wolf-spiders jump on them when they are small, and suck their juices. Ants of most kinds consider them fair game and attack them regardless of size. It is reasonable to assume that birds and lizards eat them when they can find them, and that hunting wasps carry them off to their burrows or cells, though I have never actually seen them doing so. Judging from the gusto with which some Slender Loris I once kept devoured the huge caterpillars of *Clanis phalaris*, such insectivorous mammals must take their toll. They would seize the caterpillar in both hands, and having first scrunched up the head would work steadily down the still squirming body, the green juices dribbling down them the while—a horrid proceeding. But the really insidious foes, which probably cause more destruction than all the rest put together, are the parasitic wasps and flies. One minute species of wasp lays its eggs in or on the eggs of the Hawkmoths, probably when the latter are freshly laid and still soft. Small grubs hatch out and eat the substance of the egg. The eggs which have

been attacked turn first grey, and then mottled with black and white, the white patches being the pupæ of the wasp. If kept under observation a tiny wasp will be seen to come out of a small round hole which it has bitten through the shell of the egg, and the rest of the brood will scramble out after the first at short intervals.

The caterpillars themselves are attacked by several kinds of parasitic wasps and flies, from the time they are about half-grown to maturity. The method of attack is the same as in the case of the egg, but the parasites are much larger. The grubs feed on the tissues of the living caterpillar, which carries on as usual till one day it is seen to be covered with small cocoons like ants' eggs, which stick out all over its body like almonds in a pudding. The maggots, being full fed, have made their way out through the skin of the caterpillar and formed their cocoons there. If brushed off, each cocoon leaves a black spot on the skin, and the caterpillar presently dies. Other species of maggots carry on their fell work unseen till the caterpillar is found, still holding on by its claspers and one or more pairs of pro-legs, but the upper part of its body hanging down limp and empty except for the squirming maggots. These when full fed form hard cocoons inside the empty skin, from which the perfect insects emerge in due course. Sometimes the caterpillar succeeds in pupating. The maggots continue their horrid feast, and form their cocoons inside the pupal shell. Then, instead of the beautiful moth we had expected, half a dozen nasty-looking flies or a wasp or two come out. Some species seem to be far more often attacked by parasites than others, and to suffer more in some years than in others.

It is not known what enemies the pupæ have in nature, since they are so seldom found, but when kept in artificial conditions they are attacked by the small black fly mentioned under 'breeding'.

The moths are so swift on the wing, and hide so skilfully when resting, that they probably have few enemies, but bats certainly catch them. A friend once told me that he used to find the wings of Hawkmoths in his verandah every morning, under a hook where a bat used to hang while it devoured their bodies. All observations on the subject of enemies and means of defence would be of interest.

BREEDING AND COLLECTING.

The breeding of Hawkmoths, though a somewhat exacting hobby if undertaken on a large scale, is very fascinating and of great scientific value, as so little is known about the early stages and habits. It is the only method by which perfect specimens of the moths can be obtained, and many of the more rare species cannot be obtained at all in any other way, except by chance.

'First catch your hare.' Choose some likely-looking spot where there is plenty of vegetation, and search systematically by turning over leaves and branches and pulling up strands of creepers, so that the undersides of the leaves are exposed. Keep a sharp lookout for leaves which have been eaten, and along roads, paths, stream-beds and similar places look on the ground for droppings, or *frass*, which give away the presence of caterpillars feeding somewhere above. At first one will not have much success, but the eye soon learns to

glance from leaf to leaf and to pick out an egg or caterpillar. The caterpillars found will not always be those of Hawkmoths, and beetles also feed on leaves; but beetles are ragged and untidy feeders. In the hills and other places where it gets cold in the winter, eggs and caterpillars will be found from about April to November, but where it does not get cold, may be found at any time.

It is best not to touch the eggs or caterpillars, but to pick the leaves or twigs on which they are found, and put them in a tin with small holes punched in the lid or in a wooded box. Eggs take about a week to ten days to hatch, and the young caterpillars should be supplied at once with fresh leaves of the plant on which they were discovered. After eating more or less of the egg-shell they may start feeding on the leaf, or they may wander about aimlessly without feeding. If they will not start feeding it is either because they have not been given the proper food-plant, or else, especially in a dry climate, that they require water. Sprinkle a few small drops of water on the leaves. When the caterpillar comes across a drop it will cock up its tail once or twice, and then suck it up and look for more. Don't overdo the water. The little beast may drown itself in a large drop or the leaves may become affected with mildew if the air is damp, and kill it. Fresh leaves should be given every day, and the tin or box kept clean. The best way of doing this is to turn out the contents on to a sheet of paper, and clean out the frass or droppings; put fresh leaves in and sprinkle them with water; snip off the bits of leaf on which there are unhatched eggs or young caterpillars, and put them back in the tin, throwing away the rest. As the caterpillars grow transfer them to larger tins or to wooden boxes. Keep them supplied with fresh leaves and turn out the old leaves and droppings daily, otherwise mildew will start and kill the caterpillars. Any caterpillars which die should be removed for the same reason. The food-plant can be kept fresh by putting it in water but care must be taken to prevent the caterpillars from drowning themselves by stuffing leaves or moss into the mouth of the bottle or vase, round the stems of the plant. Another method is to park out caterpillars on a bush or a bough of the food-plant, covering them with a bag of muslin or fine cloth. A rag soaked in kerosine must be wrapped round the stem or bough to prevent ants from getting at the caterpillars.

In spite of all precautions, caterpillars often die from having been attacked by parasites before they were found. The changes of skin, or moults, are also the cause of many casualties, especially when the caterpillars have not been given enough moisture. Changing skin is a tricky operation, and things may go wrong. Sometimes the old head remains fixed over the mouth-parts of the newly-formed head, and the caterpillar cannot feed. Sometimes the skin gets so dry that it will not split properly, and unbroken strands constrict the swelling body. A little assistance, if given in time, may save the caterpillar. I have often operated successfully with a paint brush dipped in water, and fine forceps or a pin!

As the caterpillar nears maturity it feeds more and more greedily, till suddenly, being full fed, it stops eating and rests motionless for a day or so. It is about to pupate, and it is time to prepare a place

where it may do so comfortably. Some Hawkmoth caterpillars pupate underground, but the larger number do so on the surface. For the former it is best to have a wooden box with 4 or 5 inches of soft earth, and for the latter a box half full of dry leaves or torn-up newspaper. If in doubt, put the leaves or paper on top of the earth. Those that wish to go underground will do so, and the others will make their cocoons on the surface. Leave them undisturbed for ten days or a fortnight, and then carefully break open the cells or

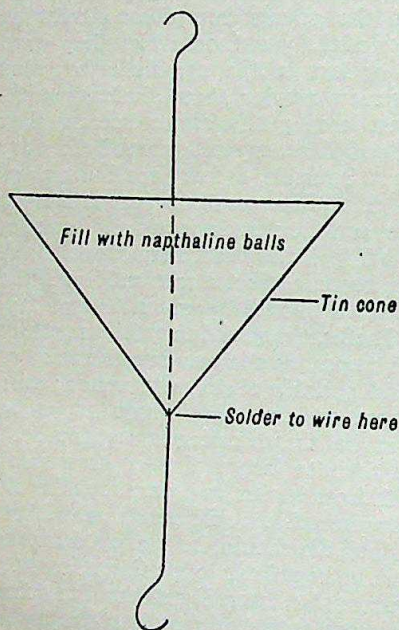


FIG. 7. An ant-proof guard.

any species of moth has come out, if more than one kind is kept in the one box. In most places it is essential to protect the caterpillars and pupæ from ants, or one day we will find half of them eaten. The various tins and boxes can be kept on a table with the legs in tins of water, or better still in tins filled with naphthaline balls. Water may evaporate, or the dog may drink it. Another way is to have hanging shelves with ant-proof guards, as in figure 7.

The pupal stage may last from a fortnight to several months, according to the species and the time of year. If the pupæ are found in June or July, the moths will probably come out in the autumn, but if formed late in the year, they will not come out till the following spring, or later. Even those pupæ which have not been attacked by parasites in the caterpillar stage are not safe from further attacks. There is a small black fly which attacks healthy pupæ, especially in the Hills. This active little brute gets through the smallest cracks in the box, and lays its eggs on the pupa. Small maggots hatch out and eat the inside of the pupa, leaving only the

cocoons and put them in another box on damp moss which has previously been baked in the sun to kill various creatures which may attack the pupæ. This box should be of a good depth so that the moths may have room to open their wings properly when they come out, and the sides and lid should be rough enough to enable them to climb up and get a foothold. It is best to remove the pupæ from the earth, first to make room for fresh caterpillars to pupate, and secondly because it is difficult to keep the earth at the proper degree of moisture. If it is allowed to get too dry, the moth may find it difficult or impossible to make its way out, and if kept too damp, the pupæ may be killed by mildew. Also we wish to describe the different pupæ, and to spot from which pupa

empty shell, and having finished one will often crawl to the next one and attack it too. In order to protect the pupæ from this pest, the box in which they are kept should be well made, without cracks, and a piece of muslin should be fastened in some way under the lid, with a good overlap. If cracks appear through the warping of the wood, paste muslin over them.

Water should be sprinkled over the moss occasionally to keep it slightly damp and any dead pupæ or empty pupal shells should be removed. When the moth is about to emerge, the pupal shell becomes soft, and in some species transparent, so that the moth can be seen through it and the pupa becomes very lively, squirming vigorously even before it is touched. The shell suddenly splits, and the moth pushes out its head, withdraws its legs, wings, antennæ and tongue from their sheaths, and finally its body from the pupal case. Its body is now soft and flabby and the folded-up wings are limp, useless appendages. The tongue is in two halves, looking like a long tube which has been split longitudinally from end to end, but after a short time the two halves fuse together, forming the tube which is used for sucking honey from flowers.

The moth's one idea is to climb to some position where it can hang by its fore-legs with space below to allow the wings to expand. The wings first hang down back to back, and expand to their full length before they are turned forwards into the normal position, which is either in the same plane as the body or sloping downwards. The moths usually come out after dark, and if left undisturbed, remain motionless, drying and hardening their body and wings, till after dark on the following night. They then start a rapid quivering motion of the wings before darting off in their first flight. They should therefore be put into a killing bottle some time before dark on the evening after they come out, or they will quickly batter their wings to pieces. They should be kept in the killing bottle for some hours before being set or put into envelopes, otherwise they may recover.

Collectors may be employed to bring in eggs and caterpillars. The average plainsman is quite useless at this game, but hillmen, such as the Khasis and the Lepchas are very clever at it. Sometimes they are too clever. Towards the end of one season, when eggs of all but the commonest species, and consequently backsheesh, were getting scarce, one of my Khasi collectors started bringing in eggs on exciting new plants, and was duly rewarded. To my disappointment the young caterpillars would not feed, and one after another died off. Then I noticed that this particular collector's eggs had a funny way of dropping off the food-plant unless carefully handled, and a close examination revealed that Nature had triumphed over Art, and that the gum used by the Khasi for sticking on common eggs was not as efficient as that used by the moth.

In order to get the full value from breeding, it is necessary to keep a careful record and notes. The best way is to give each batch of eggs or caterpillars found on each food-plant a number (I started giving letters, but soon got to Z and had to take to numbers). Note the date and locality where eggs or caterpillars were found, when the eggs hatched, when each change of skin was made and so on.

Note the colour, shape and size of the egg, and make descriptions of each stage of the caterpillar, and of the pupa. The moth can be preserved, and it is not necessary to describe it, but there is no satisfactory way of preserving the caterpillar or the pupa in its natural colours. There is a method of '*blowing*' the caterpillars, but it is messy and laborious, and the colours fade. They can be preserved in spirit (see appendix below), but again the colours fade. If we have not the time or the knowledge necessary to make detailed descriptions, the best way is to make a note of the colours, or careful paintings, and then put the specimens into spirit. If these are sent to the Society, complete descriptions can be made later. Photographs are very valuable, and if printed lightly on paper with a matt surface, can be coloured up with water colours. Pupæ can also be preserved in spirit, the colours being recorded separately.

Keep any empty egg-shells, and the cast heads of the caterpillars in glass tubes, with a slip of paper on which their number is written. The empty pupal cases and dried droppings can be kept in match boxes with the number written on them. The moths should be labelled with their number, locality and date of emergence or capture. The food-plants can be pressed, and labelled with their number. If we now send the moths and other specimens to the Society to be named, and also get the food-plants named, we have a complete record. Any parasites which come out can also be kept and labelled with the number of their host. The habits of the caterpillar in its different stages, and also of the pupa and moth should be recorded. In the case of the caterpillar, does it eat the egg-shell; any peculiarities in feeding; in what position does it rest; how does it try to defend itself when alarmed; does it change colour before pupating; does it make a cocoon on the surface or go underground to pupate. Many peculiar habits will be noticed in different species.

In the pupæ note whether the abdominal segments are stiff or flexible; are they lively or sluggish; do they make any noise; is the cremaster free or hooked into the silk of the cocoon.

In the moths note the angle at which the wings are held; do they make any noise; are they active or sluggish; fly by day or by night; do they mate in captivity; any other special habits. The method of keeping a record is shown in the appendix.

Some species of Hawkmoths may be caught when feeding at and after dusk. They are very fond of tubular flowers such as *Petunia*, Tobacco, Railway-creeper and *Plumbago*, and many other garden and wild flowers, and also bushes like *Lantana* and *Duranta*. Some of the day-flying species may be caught feeding in the morning or evening. Some Hawkmoths are attracted by light, and may be caught round lamps. 'Sugaring' does not often attract Hawkmoths, but males may sometimes be caught by putting out a female. A large series of moths may sometimes be bred by a captive female mating with a wild male, or by inducing a pair to mate in captivity when a male and female happen to come out more or less at the same time. The two sexes are usually very much alike, but the female is bigger and has thinner antennæ. It is always worth experimenting with a deformed female to see if she will attract a mate.

The moths, however obtained, may either be set or else kept in envelopes of smooth paper, folded as shown in the appendix. Set specimens take up a lot of room, and in this country are difficult to protect from mould and insects, and are also easily broken when travelling or when sent by post. It is best to set a pair or two of each species for reference, and to put the rest in envelopes to be set later.

LITERATURE.

Very little has up to now been published on the life histories of Indian Hawkmoths. In Moore's *Lepidoptera of Ceylon*, Vol. II (1882-3) there are short descriptions and somewhat crude, coloured pictures of some Hawkmoth caterpillars from Ceylon, most of which are also found in India. In the *Fauna of British India* series, Moths, Vol. I by Sir George Hampson (1892) there are a few text figures of caterpillars. Both Moore's and Hampson's books are very much out of date, the names given to species and the classification having been changed by later writers. In *Biologie und Systematik der sudchinesischen Sphingiden*, by Rudolph Mell (1922) there are good coloured illustrations and photos of many caterpillars and larvæ from South China, some of which also occur in India, and also detailed descriptions of the early stages; a few species have been described and figured in various Natural history Journals; and finally the early stages of species common to England and India have been figured and described by many writers (Richard South, Lucas etc.). Rothschild and Jordon, in their great monograph on the Hawkmoths of the world (NOVITATES ZOOLOGICAE, Vol. IX, Supplement (1903), *the Revision of the Sphingidae*) hardly touch on the early stages. The *Macrolepidoptera of the World*, by Adalbert Seitz, is now under publication in English. In this huge work there are good coloured pictures of many Hawkmoths, but none of the early stages, though there are short descriptions of some of the latter. If all the information contained in the above books be extracted, and the descriptions of the early stages of nearly one hundred species bred by a friend and myself (not yet published) be added, there still remain about 60 species of the early stages and habits of which nothing whatever is known. There is thus a wide field open to anyone who takes up the breeding of Indian Hawkmoths. The Society or the writer will be glad to receive any information regarding the occurrence, food-plants and habits of any species, and to give those who are interested any help they can. There are certain species of which only one or two moths have been obtained; others of which the caterpillars have been obtained, but have died without producing moths, and which therefore cannot be identified. Information regarding localities near Shillong, Mussorie, Dehra Dun and Bangalore with details of food-plants, etc., will be given to members of the Society who are willing to try their hand at breeding, in return for some of the specimens bred. (Address :- Lieut.-Colonel F. B. Scott, I.A., U.S. Club, Simla).

APPENDIX

PAPER ENVELOPES.

Take pieces of smooth paper of oblong shape and different sizes. Fold across as shown in Fig. 8 and then turn the ends over to make triangular envelopes. Take a moth from the killing bottle and choosing an envelope of suitable size, put the moth into it in the position shown in Fig. 9, with the antennæ folded back to protect them from injury. Write the number of the moth, locality and date of emergence or capture on the flap, and pack the envelopes fairly tightly into a box with naphthaline balls or powdered naphthaline. If kept in a damp climate, keep a sharp lookout for mildew.

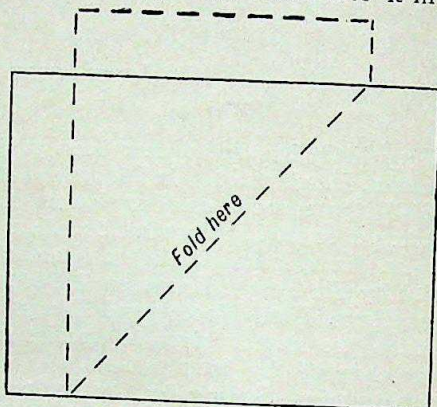


FIG. 8.

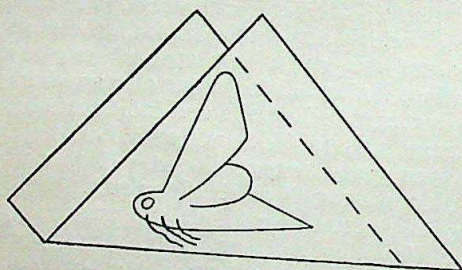


FIG. 9.

SET SPECIMENS.

The store-boxes in which set specimens are going to be kept can be treated as follows to protect the specimens from insects. Dissolve naphthaline in petrol and pour it all over the inside of the box. The petrol will evaporate and leave the naphthaline as a fine deposit. If set specimens are attacked by mildew put a few drops of pure carbolic acid onto small balls of cotton-wool, and pin the balls near the affected specimens. The bodies of Hawkmoths sometimes become greasy, and if not attended to the grease may spread over the whole specimen. Treat by soaking the whole moth in petrol till all the grease has been dissolved, or break off the body, soak it in petrol and replace in position with cement. When travelling cross-pin the body of each moth. Set the moths high up on the pins so that the pins can be driven well into the cork of the store-box, and so that the specimens, being well raised, are less liable to attacks of insects and mildew.

PRESERVING IN SPIRIT.

Make up a bottle of spirit as follows:—

Alcohol (90 per cent), three parts; water, two parts; glycerine, one part.

Put the specimens into glass tubes of suitable size, with a slip of paper on which the necessary data is written in pencil. Pour in the spirit, cork tightly, and seal the cork with sealing wax. A plug of soft paper should be placed on top of the specimen in each tube to prevent injury from shaking or washing about.

NAMING FOOD-PLANTS.

In order to get food-plants named they should first be pressed. Special botanical paper can be obtained for this purpose, but newspaper or brown paper does very well. Whenever possible flowers or fruit should be pressed with the plant. Small plants can be pressed complete with roots. Larger plants can be pressed with part of the stem removed. In dealing with trees and shrubs press a twig with leaves, and flowers or fruit attached or separate. Label each plant with its number and locality. When pressed and dry, the plants can be sent to the Forest Research Institute, Dehra Dun, or some other authority. Botanists are usually pleased to receive and name well-pressed specimens.

HOW TO KEEP A RECORD.

- No. 23. [the serial number of the species].
• *Deilephila nerii*, Linnæus. The Oleander Hawkmoth [name given by the Society].

Locality. Allahabad (in the hills, elevation etc.).

Food-plant. *Nerium odorum*, Soland. The Oleander [name given by the Forest Research Institute or other authority].

Egg. Date when found, colour, shape, size in millimetres.

Egg-caterpillar.—Describe, or put in spirit.

After first, second, third, etc., changes of skin, describe or put in spirit.

Pupa. Describe or put in spirit.

Moth. Set or put in envelope.

Habits of caterpillar, pupa and moth. Any other remarks such as common or rare, local, etc.

If possible, take one or more eggs and record :—

Date egg was found or laid.

Date on which caterpillar hatched.

Date of each change of skin.

Date caterpillar stopped feeding.

Date caterpillar left food-plant.

Date pupa was formed.

Date moth emerged.

- No. 32. *Celerio euphorbiae*, Linnæus. The Spurge Hawkmoth.

Locality. Changla Gali, 9,000 feet.

Caught when feeding on flowers at dusk on (date).

- No. 34. *Hippotion rafflesii*, Butler.

Locality. Nandidroog, Bangalore. 3,000 feet.

Caught in bungalow at 10 p.m. on (date).

A NOTE ON THE BIRDS IN THE NEIGHBOURHOOD OF MHOW.

BY

REV. F. S. BRIGGS.

The following notes are mainly from my own observations, made while stationed at Mhow, Central India, from March 1927 to October 1929, but, for the sake of completeness, I have added whatever notes on this area I have been able to find elsewhere.

My thanks are due to Mr. Hugh Whistler for identifying many of my specimens, and for checking my identification of others, also for many valuable suggestions. I also wish to thank General Betham for information with regard to certain species of birds which he found breeding near Mhow.

Most of these notes refer to the country within twelve miles of Mhow, but I have also included a few observations made at a greater distance, particularly in the neighbourhood of Barwani in the Narbadda Valley.

The country round Mhow falls into two divisions. First, the Vindhya Hills. Secondly, the Malwa Plateau. The Vindhya Hills are mostly covered with jungle, and intersected by deep and steep-sided ravines. The Plateau is largely under cultivation, but there are also on it stretches of rolling grass-land, particularly where it merges into the Vindhyan range.

The Raven. *Corvus corax* (Linn).

One seen in barracks at Mhow, 2-10-28.

The Jungle Crow. *Corvus coronoides* Gould. ♀ 7-2-28, ♂ 9-2-28.

Common in every type of country, but the majority seem to leave the Cantonment for breeding purposes. A nest containing fully fledged young was found on June 29, but young birds able to fly were seen as early as May 5.

The Indian House Crow. *Corvus splendens splendens* (Vieill.).

Commoner than the last species in Cantonments, less common away from houses, but, like the last species, many appear to leave the Cantonment area to breed. Eggs are laid in June. One was seen with a white crescent on the throat and a narrow white line round the neck, the latter concealed except when the bird stretched its neck, 23-8-27.

The Indian Tree-Pie. *Dendrocitta rufa* (Latham). ♂ 7-9-27.

Common at all times in scrub jungle. In winter a fair number invade the Cantonment.

Grey Tit. *Parus major maharattarum* Hartert. ♀ 5-3-28, ♂ 2-7-28.

The former specimen was obtained from a flock of four or five, the latter was alone, and was in full breeding condition. Both specimens were obtained at the foot of the Vindhya Hills.

The Yellow-checked Tit. *Macrolophus xanthogenys* (Vigors).

This species is fairly common. Most of them appear to leave the Cantonment during May, June, and July, presumably for breeding. During the rest of the year they are common garden birds. A nest was found on June 29 about forty feet up a Peepul outside the Cantonment. Young birds left the nest the following day.

The Chestnut-bellied Nuthatch. *Sitta castaneiventris* (Frank). Jerdon states (*Birds of India*, Vol. I, p. 386) that this species occurs 'In the Vindhyan Range of Hills.' I did not observe it.

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The Jungle Babbler. *Turdoides terricolor* (Hodgs.). ♂ 28-7-27, ♂ 29-3-28, ♀ 9-11-28.

Fairly numerous within the Cantonment; only occasionally seen elsewhere. They seem to form strong local attachments. In some gardens, one can be fairly certain of seeing a flock of them, while there are other gardens which they never seem to enter. One flock, also, is always to be seen in jungle about a mile below Simrole, though, as a rule, they belie their name by rarely being seen in jungle. They breed throughout the rains, and possibly at other times of the year as well, but most eggs appear to be laid in July. The three above-cited specimens are intermediate between *T. t. terricolor* and *T. t. sindianus*, but nearer the latter than the former.

The Common Babbler. *Argya caudata caudata* (Dumont). ♀ 30-1-28.

This species is singularly scarce, and local in its distribution. In the swamp below the bund at Bircha, a flock is always to be found, and I have seen pairs further up the Bircha Valley, and by the Ghambier River for about six miles below its source in the above-mentioned swamp. I have seen them nowhere else near Mhow, though they are common in the Narbadda Valley, especially near Barwani. Eggs found as early as March 17, and young birds in the nest as late as October 24. All the nests found were in low date-palms, amongst the fronds, at the point where they spring from the trunk.

The Large Grey Babbler. *Argya malcomi* (Sykes).

Quite the most numerous member of the family near Mhow. It rarely, if ever, comes near houses, preferring scrub-jungle and roads lined with acacia trees. In scrub-jungle it is always the first bird to give warning of the approach of an intruder, and causes a good deal of annoyance to naturalists and sportsmen by alarming other species with its call. Its flocks sometimes number as many as forty, and flocks of twenty are common. Eggs are laid in February and March, and again after the breaking of the rains, in June and July. The majority of nests are situated in acacia trees, at any height up to fifteen feet from the ground. On August 5 a pair were seen with a juvenile Pied Crested Cuckoo, which was being fed by them on open ground near the village of Gowlipura. Jerdon states that this species is 'Rare at Mhow.' (*Birds of India*, Vol. II, p. 65.). There must have been an increase in the species since his day.

The Rufous-bellied Babbler. *Dumetia hyperythra* (Frankl.). ♂ 25-6-29.

The one specimen obtained was in full breeding condition. A few individuals of this species were seen on several occasions at different seasons in Jungle at the foot of the Vindhya Hills on the Northern side of the range, near the Bombay Road. None were noted elsewhere. The following is a quotation from *On the Birds of Central India*, by Lt.-Col. C. Swinhoe and Lt. Henry Barnes¹ (Ibis 1885, pp. 52-69; 124-138). 'At present we have obtained it' (i.e. *D. hyperythra*) 'at and in the vicinity of Mhow only, in March 1882 and December 1881.'

The Yellow-eyed Babbler. *Pyciorhis sinensis* (Gmel.). ♂ 5-3-28.

Resident in small numbers in the swampy ground below the bund at Bircha. Mixed flocks of this species and *Argya caudata* were seen there on several occasions.

The Central Indian Iora. *Ægithinia tiphia humel* Stuart Baker. ♂ (juv.) 5-8-27.

Not uncommon, but erratic in its appearance. It occurs both in gardens and in scrub jungle, but rather more often in the latter type of country than in the former. It breeds about the beginning of the rains, i.e. during the latter half of June and the first half of July, but males assume their breeding plumage in April. The male takes his share in the duties of incubation, and one was observed sitting on a nest and singing vigorously on June 25th.

¹ Henceforth referred to for brevity as S. & B.

Jerdon's Chloropsis. *Chloropsis jerdoni* (Blyth).

'Found at Mhow.' (Jerdon, Vol. II, p. 98.)

The Central Indian Red-vented Bulbul. *Molpastes hæmorrhous pallidus* Stuart Baker. ♂ 3-8-27, ♀ 13-2-28, ♂ 29-12-28, ♀ 25-2-29.

Numerous in every type of country except thick jungle. In winter, they gather in flocks up to a dozen or more in strength, but within the flocks, appear to keep largely in pairs. These flocks invade gardens during the winter, beginning to disintegrate early in March. A few individuals remain in gardens all the year, and breed there, but scrub jungle appears in this area to be their favourite type of country for breeding. Eggs found between May 6th, and September 5th. The subspecific name *pallidus* covers all birds intermediate between *intermedius*, *bengalensis* and *hæmorrhous*; but the Mhow specimens are nearer to *hæmorrhous* than to the two former races.

The Spotted-grey Creeper. *Salpornis spilonotus* (Frank).

Lt. Young states that he shot one near Mortakka on April 4th. (*J.B.N.H.S.*, Vol. XVI, p. 514).

The Northern Indian Pied Bush-Chat. *Saxicola caprata bicolor* (Sykes) ♀ 5-10-28, ♂ 27-10-28.

A winter visitor, not very numerous, seen chiefly in open country and swampy ground. Earliest and latest dates seen; September 23 and March 25. There seems to be some misconception about the status of this bird. The *Fauna*, (2nd edn., Vol. II, p. 27,) states:—'. . . is a resident almost throughout its habitat but it seems to leave its highest ranges in winter, and in some places moves locally from the plains to the adjacent hills for breeding purposes.' From my own small experience, its movements seem to be more marked than is here suggested. In the Peshawar valley it is mainly a summer visitor, though a few individuals spend the winter there. In the same area it has also a secondary movement from the Valley to the surrounding hills *after* breeding, and before moving south for the winter. Round Mhow it is, both on the Plateau and in the Vindhya Hills, purely a winter visitor. At Poona it is common in the winter, but leaves before the summer. There, however, the movement may be only local, as it breeds in considerable numbers round Khandala, less than forty miles away. Mr. Hugh Whistler states that 'It is a very marked summer visitor throughout most of the North-West, but here and there a few individuals are resident.' From these notes it appears to be very largely a migratory race.

The Stone-Chat. *Saxicola torquata* (Linn.). ♂ 12-12-27, ♀ 23-1-28, ♂ 14-9-28. (juv.).

A winter visitor, much more numerous than the last species. It is to be found wherever there are not too many trees, but chiefly in swampy and rocky country. Earliest and latest dates seen: September 9, and March 25. The three species, none of which were obtained in swampy ground, belong to the race *indica*. But Jerdon states, (*J.*, Vol. II, p. 130), with reference to *Saxicola leucuroides* (= *Saxicola torquata leucura*), that it is 'Not uncommon about Mhow in the cold weather.' Both races, therefore, appear to occur.

The Pied Wheatear. *Ænanthe picata* (Blyth). ♂ 1-10-28.

The above-mentioned specimen, obtained about a mile south of Mhow on the Bircha Road, and a female seen a few weeks later on the road to Indore are the only records I have of the species in the area.

The Wheatear. *Ænanthe ænanthe ænanthe* (Linn.).

'I got a specimen near Mhow in the cold weather.' (*J.*, Vol. II, p. 132).

Gould's Desert Wheatear. *Ænanthe deserti atrogularis* (Blyth.) ♂ 10-2-28.

My only other record is of one seen about mile 14 on the Neemuch Road, 12-11-28. Jerdon, however, states (*J.*, Vol. II, p. 133):—'Common at Mhow in the cold weather.'

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The Brown Rock-Chat. *Cercomela fusca* (Blyth).

A pair seen in Mhow itself 22-1-29. It seems strange that this should be the only record of so common a bird.

The Black Redstart. *Phœnicurus ochrurus phœnicuroides* (Moore).

A common winter visitor. Earliest and latest dates seen : Sept. 17 and April 10. This species seems to form strong local attachments. One can be fairly certain of seeing an individual within a few yards of certain trees, once one has learned where to look. The same trees are favoured year after year. Males always appear greatly to outnumber females. As the male is for the first year exactly like the female in appearance, and breeds in that immature dress, one would expect the reverse to be true. It would appear, therefore, that most of the females and immature males migrate to some other locality from that favoured by the males. They are very bold, and in the autumn of 1928 one frequently came into my bungalow to catch insects, and on one occasion was catching them in the church throughout the morning service, entirely undisturbed by the singing of the congregation.

The Eastern Red-Spotted Bluethroat. *Cyanosylvia succica pallidogularis* (Saruday). ♀ 30-1-28.

Not uncommon, particularly in reed-beds, during the winter. It arrives late and departs early, its earliest and latest dates being Oct. 1 and Mar. 25.

The Brown-backed Indian Robin. *Saxicoloides fulcata cambaiensis* (Lath.).

Common and resident, in gardens, cultivation, and scrub-jungle. Eggs are laid in April, and probably up to the middle of June.

The Magpie Robin or Dayal. *Copsychus saularis* (Linn.).

This species is fairly common in gardens and cultivation. On several occasions I noticed the female singing to the male. No nest of the species was found, but very young birds, which had evidently only just left the nest, used to make their appearance in the middle of July. This species resents the presence of members of the last species in any garden in which it has taken up its abode, and does its best to drive them off, attacking them with great vigour.

The Dark Thrush. *Turdus obscurus* Gmel.

A bird which was taken for this species was seen on the Ghambier River on the outskirts of Mhow, on the evening of 2-2-29. This was during a spell of phenomenally cold weather which was making itself felt over the whole of Northern India. The bird seemed very tired, but I was unable to obtain it as a specimen, so the identification must be regarded with suspicion.

The Indian Blue Rock Thrush. *Monticola solitaria pandoo* (Sykes). ♀ 2-4-28.

A winter visitor in small numbers, in addition to which many pass through on the Spring migration. Females seem to be more numerous than males. Earliest and latest dates : Oct. 16 and Apr. 1.

The European Red-breasted Flycatcher. *Siphia parva parva* (Bechst.). ♂ 6-2-28.

Mainly a passage migrant in October and April, but a few seem to winter in the district. Red-breasted males are greatly in the minority. The one specimen obtained belonged to the typical race. Earliest and latest dates : September 24 and April 17.

Tickell's Blue Flycatcher. *Cyornis tickelli* (Blyth).

Not uncommon in the Vindhya Hills, both in scrub and in thicker jungle. General Betham took their eggs in the valley below Simrole in May. A pair were seen courting in the same valley in June.

The Verditer Flycatcher. *Stoparola melanops* (Vigors).

One seen in garden 30th November 1928. 'Mhow and Manpore are at present the only places where we have obtained it' (S. & B.).

The Brown Flycatcher. *Alseonax latirostris* (Raffl.).

General Betham took the eggs of this species in the valley below Simrole. I did not see any birds of this species in the Mhow district, but a bird described to me by a careful observer appeared to belong to this species. S. & B. record having obtained a single specimen at Manpore.

The Paradise Flycatcher. *Terpsiphone paradisi* (Linn.).

This species seems to be resident in small numbers in the Vindhya Hills, and to occur as a passage migrant on the plateau. General Betham took eggs in the valley mentioned above. My own observations of the species are not very numerous, so may be given *in extenso*.

- 1927 Mar. 27. Male in mixed chestnut and white plumage opposite bungelow.
 May 28. Several females by Simrole Road.
 Sep. 21. Numerous, both sexes, Jeshwantnagar.
 Oct. 12. Several below Simrole.
 1928 Apr. 5. One adult male, Indore.
 June 22. Female in Jungle about two miles S. of Simrole Road.
 Sep. 10. Females (or Juveniles) numerous at Jeshwantnagar.
 1929 Mar. 25. One adult male Bircha.
 June 12. Female by Ghambier River.
 July 3. Adult male with ribbon feathers missing, Fort *glacis*.
 Sep. 27. Female, Mile 7 on Bombay Road.

The White-browed Fantail Flycatcher. *Rhipidura aureola* (Less.).

Fairly common, and resident, but subject to local movement. In the spring and summer they are common along the road between Mhow and Simrole, and in the scrub jungle to the south of the road, but do not appear to occur anywhere else in the district. During the winter they spread over the whole district frequently coming into gardens. On several occasions in the winter pairs of them were seen feeding with a flock of *Phylloscopus collybitus tristis*. Breeding appears to commence about the middle of February.

The Indian Grey Shrike. *Lanius excubitor lahtora* (Sykes). ♀ 17-6-27.

Seen at all times of the year, but in distinctly greater numbers in summer than in winter. It is mainly a bird of open grazing grounds and roads sparsely lined with trees, particularly *Acacia*. The one specimen obtained showed some signs of breeding, and a nest containing fresh eggs was found on April 17, but breeding appears to take place mostly in the rains.

The Bay-backed Shrike. *Lanius vittatus* (Valenc.). ♂ 21-12-28.

The one specimen obtained was in juvenile plumage. This is by far the commonest shrike about Mhow. It is even more numerous in winter than in summer. Breeds during the rains, and usually has two broods.

The Rufous-backed Shrike. *Lanius schach* (Linn.). ♂ 31-10-27; ♂ 28-11-27; ♀ 16-6-28.

The above specimens are all intermediate between *erythronotus* and *caniceps*, and cannot be assigned definitely to either race. Nests containing eggs found between June 16 and Aug. 20. All the nests found round Mhow were much less bulky and contained less wool than those I have seen in the Peshawar District and in Kashmir. The species is not very common about Mhow at any time, but there is a noticeable increase in numbers in the autumn.

The Brown Shrike. *Lanius cristatus* (Linn.).

Seen very occasionally in winter and early spring. Also recorded from Mhow by S. & B.

The Indian Common Woodshrike. *Tephrodornis pondiceriana pondiceriana* (Gmel.). ♂ 19-6-28, ♀ 15-10-1928.

Fairly numerous in scrub-jungle, but rather erratic in its appearances. Rarely seen in winter. One of the two specimens obtained on June 19 was a

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juvenile which could not very long have left the nest, and was still being fed by its parents.

The Small Minivet. *Pericrocotus peregrinus* (Linn.) ♂ 26-10-27; ♀ 16-11-27.

Common and resident, but, like the rest of the minivets, wanders a good deal in small parties in search of food. It breeds in March, and apparently again in the earlier part of the rains. On one occasion a pair of females were seen fighting very fiercely for the favour of a male, who looked on with apparent interest, but took no part in the dispute.

The White-bellied Minivet. *Pericrocotus erythropygius* (Jerdon). ♀ 9-5-28.

This species was numerous on the road to Bircha on the day the specimen was obtained and two days later. It was occasionally seen again, each time either in spring or in autumn. It may therefore be regarded as a passage migrant only in this area.

The Large Cuckoo-Shrike. *Graucalus macei* (Less.).

Status uncertain. From September to May it is a common bird in gardens and in cultivated country wherever there are tall trees. Nearly always they are seen either in twos or threes, but I have one record of a flock of six. Between May and September I have only five records of this species in the area. They are as follows :—

- 1928 July 9. One in thick jungle, S. of Mhow, Simrole Rd.
- July 10. Do. do.
- 1929 June 11. Three seen beyond polo-ground.
- July 8. One in same place as previous July.
- Aug. 6. One west and one east of polo-ground.

The behaviour of those seen in July in both years suggested that they had nests, though I was unable to find them. On September 27, 1930, a pair were flying round what appeared to be a half-finished nest about forty feet up in a Peepul tree on the outskirts of Mhow. Twice while I watched, the female flew away with a little of the material of the nest in her bill. The next day all the material had disappeared. As it was in a position quite inaccessible to a human being it may be assumed that the birds had themselves removed it all. On October 8, a pair were seen courting vigorously in a tree at the side of a road in Indore. From the above observations it would seem probable that this species is mainly a winter visitor to the immediate neighbourhood of Mhow, and makes a local migration, probably to the jungles of the Vindhya Hills, for breeding, but that they may sometimes breed a second time later in the year on the plateau.

The Black Drongo or King Crow. *Dicrurus macrocerus* (Vieill.).

Numerous at all times, but even more numerous in winter than in summer. Breeds mainly in June and July.

The Ashy Drongo. *Dicrurus leucophæus* (Vieill.).

S. & B. procured specimens at Mhow in October.

The White-bellied Drongo. *Dicrurus cærulescens* (Linn.).

Only occasionally seen. It appears to be resident in small numbers, and is local in its distribution. The one place where one can generally be fairly certain of seeing several is over the river at Indore. Its notes are similar to those of the King Crow, but much less harsh than the usual call of the latter, and more like its softer, early-morning call.

Acrocephalus.

'A note on the Asiatic Members of the Genus *Acrocephalus*' by Mr. Hugh Whistler (The *Ibis*, July 1928, pp. 449-453) suggested the possibility that some members of that genus not yet recorded as breeding in the plains of India, may actually do so. Hence I spent some considerable time in reed-beds looking for the nests of Reed-Warblers. The results were interesting but inconclusive. A fringe of reeds grows along the side of the overflow from Bircha Lake. In these reeds I found the only trace in the

district of *Acrocephali* breeding. On August 5, 1928, there were two nests, both of them typical Reed-Warbler nests, in these reeds. One was slung between about four reed-stems; the other was attached to a reed-stem and to two or three thorny, upright branches. The former nest was empty, and the latter contained one egg, strongly reminiscent of the egg of *Sylvia atricapilla*. I left it in the hope that more would be laid, and that I might see the parent birds. On examining the nests a few days later, however, I found both empty. In 1929, I again kept my eye on the same fringe of reeds. In August, I again found a nest exactly similar in all respects to the nest I found in the preceding year. On August 9, when I was looking at it, a small bird which might quite well have been a Reed-Warbler was showing great anxiety in some bushes behind the nest. As the nest was empty, however, I went away at once so as not to frighten the owner. I visited the nest on several subsequent occasions, without, however, finding any eggs.

Pallas's Grasshopper Warbler. *Locustella certhiola* (Pall.).

Jerdon says that he met with it in 'Long grass in the neighbourhood of Mhow, during the rains.' (Jerdon, Vol. II, p. 159).

The Tailor-Bird. *Orithotomus sutorius* (Forst.).

Very common and resident. There appears to be at least one pair of these birds to every garden, besides which they are numerous in scrub-jungle. They breed from June to the end of September, and appear usually to have two broods. Some writers state that it is the hen Tailor-Bird that does all the work in building the nest. In the case of three nests built in my garden at Mhow, the male did the greater part of the work of sewing the leaves together, and each took a share in building the nest itself. Two nests built in the summer of 1929 were lined almost entirely with bits frayed off from a rope for opening and shutting one of the *roshandans* of my bungalow. The eggs were taken from the former of these nests, probably by a squirrel, and the male Tailor-Bird was seen removing a good deal of the lining to use on a second nest about twenty yards away.

The Streaked Fantail Warbler. *Cisticola juncidas* (Rafinesque). ♀ 30-1-28.

Fairly common, but rather erratic in its appearances and disappearances. It is generally to be seen at Bircha.

Franklin's Wren-Warbler. *Franklinia gracilis* (Frankl.). ♀ 15-8-27, ♂ 2-7-28.

Fairly common and resident. This species is chiefly found in bushes by the side of roads, and in gardens. Breeds in the rains. A pair seen feeding fairly well-grown young on 21-8-29.

The Rufous-fronted Wren Warbler. *Franklinia buchanani* (Blyth).

Jerdon states that he obtained a specimen near Mhow. (Jerdon, Vol. II, p. 187.)

The Booted Tree-Warbler. *Hippolais scita* (Eversm.). ♂ 4-4-28.

The above-cited specimen was excessively fat, suggesting that it was on the point of migrating. The species was not identified on any other occasion.

Hume's Lesser Whitethroat. *Sylvia althæa* Hume. ♀ 1-10-28.

This specimen was obtained from a flock of three or four. No other record.

The Desert Warbler. *Sylvia nana* (Hemp. & Ehr.).

'Found at Mhow.' (Jerdon, Vol. II, p. 209).

The Indian Lesser Whitethroat. *Sylvia curruca affinis* (Blyth). ♂ 31-10-27, ♀ 14-11-27.

Very numerous on passage in the spring and autumn, a considerable number also wintering in the neighbourhood of Mhow. It is chiefly found in open scrub-jungle with plenty of acacia bushes, but also occurs in gardens.

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The Siberian Chiffchaff. *Phylloscopus collybita tristis* (Blyth). ♂ 28-12-27, ♀ 9-1-28.

Occurs fairly plentifully in winter in small flocks. On several occasions a flock of this species was seen following a pair of Fantail Warblers about and feeding with them. They occur in every type of country.

The Olivaceous Willow-Warbler. *Phylloscopus indicus* (Jerd.). 0? 15-10-28.

The above specimen was obtained from a flock feeding in trees near Jeshwantnagar. They ran about the trunks and branches searching the bark for insects in the manner of Tree-Creepers.

The Greenish Willow-Warbler. *Phylloscopus nitidus viridanus* (Blyth.) ♀ 10-9-28.

This specimen, obtained from a mixed flock of *Phylloscopi* feeding in the trees overhanging Jeshwantnagar Lake, is the only record.

The Streaked Wren-Warbler. *Prinia gracilis* (Licht.).

'Abundant on the Vindhya Mountains near Mhow.' (Jerdon, Vol. II, p. 172).

Stewart's Ashy Wren-Warbler. *Prinia socialis stewarti* (Blyth).

Fairly numerous and resident, rarely seen far from water. The only nests found were of the Tailor-Bird type, and always close to a stream. Breeds about the end of March and the beginning of April, and again in the rains (August).

The Indian Wren-Warbler. *Prinia inornata inornata* (Sykes). ♂ 29-7-27, ♀ 21-9-27, ♀ 8-6-28, ♂ 17-9-28.

Numerous and resident. It is always commoner near water than elsewhere, but also occurs in cultivation well away from water. Every nest found was close to water, the majority being either in reeds or in Marestail. By far the greater majority of eggs are laid in the last fortnight in August, but a few are laid in September.

The Indian Oriole. *Oriolus oriolus kundoo* (Sykes).

This species occurs at all seasons, but is distinctly more numerous in spring and autumn than either in summer or winter. It breeds in May.

The Indian Black-naped Oriole. *Oriolus chinensis indicus* (Jerdon).

'One seen at Manpore in June 1882.' (S. & B.).

The Rose-coloured Starling. *Pastor roseus* (Linn.).

In March 1927 I saw several large flocks. In the two succeeding years their numbers were much smaller. Flocks were also seen four times in April, twice in February, and once in January. On 11-3-29 a mixed flock, consisting of five Common Mynahs and three Rose-coloured Starlings flew over the *glacis* of the fort.

The Black-headed Mynah. *Temenuchus pagodarum* (Gmel.).

Fairly numerous. There seems to be a slight increase in numbers before the breeding-season, which extends from the middle of April to the middle of June.

The Common Mynah. *Acridotheres tristis tristis* (Linn.). ♂ 28-7-27.

Very common and resident. Eggs laid about the middle of July. A young bird, not quite fledged, which had fallen from its nest was picked up in August 1928, brought up by hand till it was big enough to look after itself, and then released. It visited the bungalow daily till about April, generally timing its visits to coincide with meal-times. It showed a strong dislike to anything containing chocolate, but otherwise would eat anything, and its great partiality for all dairy products, especially cream and cheese, made it necessary to keep a very wary eye on those articles when he was about. He was entirely

fearless, and walked about the table during meals. In April he disappeared, but reappeared, rather to our surprise in September, continuing to haunt the house with the same persistence and fearlessness till we left Mhow at the end of October.

The Bank Mynah. *Acridotheres ginginianus* (Lath.).

'I got it at Mhow, . . . though rare, and on the banks of the Narbadda.' (Jerdon, Vol. II, p. 327).

The Baya or Weaver-bird. *Ploceus philippinus* (Linn.). ♂ ♀ 19-5-28, ♀ 26-12-28, ♂ ♂ ♂ 14-6-29, ♂ 29-6-29.

Common and resident. The ♂ obtained on 19-5-28 was just beginning to assume breeding plumage; the four specimens obtained on 14-6-29 were in varying stages of moult, but all nearly in complete breeding plumage; and the last specimen was in complete breeding plumage. Their second moult appears to take place immediately after breeding, but I obtained no specimens to illustrate it. Work on nests is begun before the end July, but the earliest date on which I have found eggs is September 7. The latest date on which I found eggs was October 1st. Several books state that there is never any lining in a Baya's nest. Every nest I examined in the neighbourhood of Mhow had at least a few feathers, and in several cases the eggs were resting on a thick mat of feathers. In one or two cases the feathers were white, but usually, they were pale grey.

The White-throated Munia. *Uroloncha malabarica* (Linn.). ♂ 3-8-27.

Resident, but subject to local movement in accordance with the supply of food. They breed irregularly from August to April, but the majority of eggs are laid in January and February.

The Green Munia. *Stictospiza formosa* (Lath.).

A few of these very beautiful little birds were seen in a large flock of Amadavats near Killod, South of Mhow, 8-6-28. Jerdon says (Vol. II, p. 361):—'Occasionally caught and caged . . . at Mhow.'

The Amadavat. *Amandava amandava* (Linn.).

A flock of about fifty seen near Killod, 8-6-28. No other record.

The Common Rose-Finch. *Carpodacus erythrinus* (Pall.). ♀ 9-11-28.

Winter visitors. A large flock seen 9-11-28, otherwise only one or two individual birds.

The Yellow-throated Sparrow. *Gymnoris xanthocollis xanthocollis* (Burton). ♀ 12-12-27; ♂ 20-2-28; ♂ 28-5-28; ♂ 19-6-28.

The status of this species is somewhat puzzling. About the end of February, they begin to build in considerable numbers, and by the end of April, young birds begin to appear. In May they cease to be evenly distributed over the countryside, and gather into flocks usually of about a dozen to twenty individuals. These flocks are seen mainly in scrub-jungle. Soon after the rains break, (i.e. about the end of June or beginning of July), they entirely disappear and I have only one record of the species in July, (9-7-29), and none were recorded after their departure in the early rains was November, 6th, two days after heavy and unseasonable rain. They were again seen on the 7th, 8th, 23rd, and 24th, of the month, each time in small parties. In December they were seen four times, each time in large flocks. In January they were fairly frequently seen, generally in smaller flocks than in the preceding month, and before the end of the month they were beginning to sing and fight. Throughout February they were very frequently seen but in very varying numbers, the impression given being that flocks of them were passing through the district, while some individuals were settling down to breed. A male shot on February 20, was in full breeding condition, and they were seen carrying building materials on February 29. In 1928 their appearance after the rains was earlier than in 1927. On October 19 and 20 they were very

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numerous fifty miles south of Mhow, beyond the Narbadda River, and on the 21st, one was seen at Mhow. From that date till October 29 the notes correspond pretty closely with those already given. The above observations suggest that the breeding birds leave Mhow for the rains, and that there is an influx of other individuals of the species, possibly those which have bred in the Punjab, in the winter. If these winter visitors do come from the Punjab, however, they must delay a long time on the way, as they are amongst the first summer visitors to leave the Punjab.

The Indian House-Sparrow. *Passer domesticus indicus* (Jard. & Selby).

More numerous in the bazar than elsewhere, but by no means as numerous about Mhow as in many other parts of India. Breeds irregularly almost throughout the year.

The Grey-headed Bunting. *Emberiza fucata* Pall.

'Seen at Mhow.' (Jerdon, Vol. II, p. 276).

The Grey-necked Bunting. *Emberiza buchanani* Blyth. ♂ 6-2-28.

A pair were seen in scrub below the fort on April 25 and 26, 1929. Otherwise the above-cited specimen obtained in scrub near Bircha Lake, is my only record of this species.

The Red-headed Bunting. *Emberiza icterica* Eversm.

'Tolerably abundant at Mhow.' (Jerdon, Vol. II, p. 379).

The Crested Bunting. *Melophus melanicterus* (Gmel.).

Appears to be a summer visitor in considerable numbers to the Vindhya Hills. Only seen once in winter, 8-12-28, when a small party of one adult male and a few hens or immature birds were seen feeding in the long grass on the bund of Bircha Lake. General Betham states that he twice took the egg of *Cuculus canorus* from the nest of this species near Simrole.

The Sand Martin. *Riparia riparia* (Linn.).

'Saw it occasionally at Mhow.' (Jerdon, Vol. I, p. 163).

The Dusky Crag-Martin. *Ptyonoprogne concolor* (Sykes).

Fairly numerous in summer, much less so in winter. Eggs laid in August and September. Nests placed both on cliffs and buildings. Lt. Young found young birds of this species in nests in the Narbadda Valley in April (*J.B.N.H.S.*, Vol. XVI, p. 315). This suggests the question as to whether the species breeds twice; once in the Narbadda Valley in the spring, and once on the Plateau in the latter part of the rains.

The Common Swallow. *Hirundo rustica* Linn.

Occurs in immense numbers on passage in the autumn, and is occasionally seen throughout the winter. Only one record in the spring, *viz.* Indore, 12-3-27.

The Indian Wire-tailed Swallow. *Hirundo smithii* fillferra (Stephens).

Resident in considerable numbers. Eggs found at various times between February 17 and September 25. The same nest was used in April and September 1927, and in February and May 1928. The last time the nest was used, it cracked off the cliff to which it was attached, presumably owing to the dry heat, when containing two young birds nearly ready to fly, but caught on a projecting root, where it remained till the young left some days later.

The Indian Cliff Swallow. *Hirundo fluviicola* Jerdon.

Occasionally seen, chiefly in winter. A very large colony breeds on the piers of the railway bridge over the Narbadda at Mortakka, about thirty miles from Mhow in July. Apparently they breed twice in the year in the Narbadda Valley, as Lt. Young (*J.B.N.H.S.*, Vol. XVI, p. 515), states that on April 9

he examined a colony of these birds, and found that most of the young had just left the nests.

Hodgson's Striated Swallow. *Hirundo daurica nepalensis* (Hodgs.). ♀ ♀ ♀ 25-1-29.

The three specimens were all *nepalensis*. The winter birds look different from the breeding birds, and probably belong to a different race. The breeding birds arrive in May, and breed during the latter part of the rains. Nests containing young having been found from August 25 to October 12. The one nest found on the latter date contained one nearly fledged bird, which appeared to have been deserted by its parents. During the latter half of October I have no record of this species for any of the three years. There is a great influx of Striated Swallows about the beginning of November, and they occur in large flocks during that month, December and January. No records of the species for February, March, or April.

The Indian White Wagtail. *Motacilla alba dukhunensis* (Sykes). ♀ 7-11-27, ♀ ♀ 5-10-28.

The commonest of the migratory Wagtails. They are to be seen in immense numbers every evening in the winter on the polo-ground, where they appear to be entirely undisturbed by any match which may happen to be in progress, merely flying up when the ponies approach very close to them, and settling again at once. About sunset they fly off in flocks in a south-easterly direction. Earliest and latest dates seen : September 21, and April 7.

The Masked Wagtail. *Motacilla alba personata* (Gould).

One seen on the roof of the post office, 6-12-28.

The Large Pled Wagtail. *Motacilla maderaspatensis* (Gmel.).

Several pairs are resident at Bircha, where they breed in a punt and on the pumping station in the hot weather, and the rains. Rarely seen elsewhere.

The Grey Wagtail. *Motacilla cinerea* Tunstall.

Presumably this is *caspica*, but no specimen was obtained. This is usually the earliest of the migrant Wagtails to arrive, and the latest to depart. Earliest and latest dates September 6 and April 29. On 13-9-27, one adult and two juveniles were seen together. This is the least social of the migratory Wagtails, never occurring in large flocks. Individual birds seem to occupy a certain very restricted area for the winter, and, once they have settled down, may be seen daily in the same place.

The Indian Blue-headed Wagtail. *Motacilla flava beema* (Sykes). ♀ 1-10-28, ♂ 5-10-28, ♂ 24-10-28, ♂ 30-11-28.

Seen from the end of September till March. They occur in flocks, generally near water and in swampy ground, but sometimes on dry pasture-land. Frequently they are found in mixed flocks with *M. alba*. They appear to roost in great numbers on the open ground on One Tree Hill. Considerably more numerous on the autumn passage than, later on, in the winter or on the spring passage.

The Western Yellow-headed Wagtail. *Motacilla citreola veræ* Buturlin. ♂ 7-11-27, ♂ 4-1-28, ♂ 25-3-29.

Winter visitors, arriving about the end of September or beginning of October, but no exact dates recorded, as it is by no means easy to distinguish between this species and the last in the field. This species never appears to occur on large flocks, or away from water, and is chiefly seen on the margins of tanks and ponds. Most of the males are in breeding plumage by the end of March, and leave early in April, but one was seen by Bircha Lake on 11-5-28 which had not completely assumed breeding plumage.

The Tree-Pipit. *Anthus trivialis trivialis* (Linn.). ♂ 5-12-27, ♂ 27-1-28, ♀ 30-1-28, ♂ 6-2-28.

A very common winter visitor, found in every type of country except swamp and thick jungle. It is very common in gardens. Earliest and latest dates, September 26 and April 13. During the greater part of its stay in the district, it is found in small flocks, but the flocks break up into pairs during the last month before departure.

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The Persian Rock-Pipit. *Anthus sordidus decaptus* Meinertz. ♂ 28-12-28.

The single specimen obtained seems to belong to this race. It is occasionally seen in winter, occurring either singly or in pairs. It frequently perches on the top of haystacks. Open grassland was the only type of country in which it was seen. Very shy and difficult to approach.

Richard's Pipit. *Anthus richardi richardi* (Vieill.). ♂ 28-11-27.

The above specimen was obtained near Killod, about three miles from Mhow. No other record.

The Indian Pipit. *Anthus richardi rufulus* (Vieill.). ♀ 29-7-27; 0? 24-8-27, ♂ 13-2-28; ♀ 4-4-28; ♀ 11-5-28; ♀ 28-12-28.

Numerous and resident, breeding in the rains. Occurs in all types of open country. In the Narbadda Valley, Lt. Young found three much incubated eggs of this species on April 9. (*J.B.N.H.S.*, Vol. XVI, p. 515).

The Eastern Tawny Pipit. *Anthus campestris griseus* Nicoll. ♂ 14-2-29.

This specimen was obtained about three miles east of Mhow. I have no other record, but Jerdon describes it as 'Abundant at Mhow.' (Jerdon, Vol. II, p. 235).

The Yarkand Short-toed Lark. *Calendrella brachydactyla longipennis* (Eversm.). ♀ 12-11-28.

The above specimen was obtained from a very large flock on open ground about fourteen miles west of Mhow, and is the only record. The birds were very wild and difficult to approach.

The Red-Winged Bush-Lark. *Mirafra erythroptera erythroptera* (Jerdon). ♀ 20-8-27; ♂ 16-9-27; ♀ 23-1-28; ♂ ♀ 1-6-28; ♂ 16-6-28.

Fairly numerous and resident, keeping to the broken ground in the neighbourhood of the Vindhya Hills. It is mainly a bird of open grassland, but is also met with in fairly open scrub-jungle. Breeds in the rains. Jerdon states that he 'did not find it at Mhow.' (Jerdon, Vol. II, p. 419).

Sykes' Crested Lark. *Galerida deva* (Sykes). ♂ 8-8-27, ♂ 16-9-27, ♀ 27-3-28, ♂ 26-5-28, ♀ 8-6-28, ♂ 11-6-28, ♂ 31-8-29.

Chiefly, if not entirely, a summer visitor. One Crested Lark was seen in the winter, but I was not certain to which species it belonged. From March to September it is common in open, and often in swampy country. A nest containing two fresh eggs was found in the shelter of two stones in a stubble-field on 10-8-29.

The Indian Rufous-tailed Finch-Lark. *Ammomanes phoenicura phoenicura* (Franklin). ♂ 23-11-27, ♂ ♀ 27-2-28, ♀ 1-6-28.

Very numerous, sometimes in large flocks and sometimes singly, in winter. About March the numbers are reduced considerably, but some may be seen throughout the year. Of the two specimens obtained on 27-2-28, the male was in full breeding condition, and the ova of the female were beginning to enlarge. Jerdon says of this species:—'I have seen it north of the Narbadda, at Mhow and Saugor, but rare.' (Jerdon, Vol. II, p. 422).

The Pale Ashy-grey Finch-Lark. *Pyrrhuloxia grisea siccata* (Ticehurst). ♂ 20-2-28, ♀ 3-9-28.

Breeds in March and April on open, dry grassland. During the rest of the year they keep mainly to the same type of country, but are occasionally seen in cultivation in small flocks.

The White-eye. *Zosterops palpebrosa* (Temm.).

This species is very erratic in its appearances. It occurs at all seasons, but is rarely seen except after rain has fallen. Whether this is only because rain, by bringing out the insects, makes it more lively and therefore more noticeable, or whether there is some local movement, is uncertain. The same phenomenon is noticeable at Peshawar.

The Purple Sunbird. *Cinnyris asiatica asiatica* (Latham). ♂ 9-7-28.

Common in gardens and scrub-jungle. The majority of the species appear to leave the neighbourhood during the rains, gradually returning during the autumn. The species is notoriously irregular in its plumage-changes, but in this area the majority of the males seem to have adopted their non-breeding plumage by the beginning of August, and to have reassumed their breeding plumage by the end of November. The one specimen obtained was moulting from breeding into non-breeding plumage. Nests containing fresh eggs found between March 3 and June 25. Eggs are incubated for thirteen days. A nest containing two eggs was found on 14-3-29. The eggs hatched, and the young were successfully reared. On May 1, seeing a Sunbird again visiting the same nest, I examined it, and found that it contained one freshly hatched chick. There was no trace of a second chick or egg.

The Thick-billed Flower-Pecker. *Piprosoma squalidum squalidum* (Burton). ♀ 2-11-28.

This specimen was shot from a party of three or four in scrub-jungle. No other record.

The Indian Pitta. *Pitta brachyura* (Linn.).

Not observed, but General Betham took its eggs in the valley below Simrole.

The Golden-fronted Pied Woodpecker. *Lelopicus mahrattensis* (Lath.). ♂ 25-6-28, ♀ 8-10-28.

All three specimens are intermediate between the northern and southern races. Resident. Found alike in gardens, cultivation, along tree-fringed roads, and in scrub-jungle. A nest found on March 21, in a hole in an acacia, about twelve feet from the ground, contained one hatching egg, one addled, and two infertile. One of the parent birds went off when the operation of cutting into the nest with an adze was begun, but the other did not leave till the excavation was completed and she was being handled.

The Golden-backed Woodpecker. *Brachypternus benghalensis* (Linn.).

Resident, in smaller numbers than the last species.

The Black-backed Woodpecker. *Chrysocolaptes festivus* (Bodd.).

Jerdon states that this species occurs 'in the Vindhyan Mountains near Mhow'. (Jerdon, Vol. I, p. 283.)

The Wryneck. *lynx torquilla* (Linn.). ♀ 17-3-28, ♂ 30-9-28.

Appears to occur mainly as a passage migrant in spring and autumn, though some may stay through the winter. Earliest and latest dates Sept. 30 and Mar. 17.

The Northern Green Barbet. *Therecyrx zeylanicus caniceps* (Franklin).

Occurs in 'the jungles of the Vindhyan range of hills' (Jerdon, Vol. I, p. 311).

The Coppersmith. *Xantholæma hæmacephala lutea* (Lesson). ♀ 20-2-29.

The above-cited specimen was obtained in rather an unusual way. Seeing two jungle crows pecking at a Coppersmith on the ground I drove them off, and picked up the Coppersmith, apparently little the worse, though unable for the time being to fly. However, in an hour or two it died. The species is resident, and very numerous in the gardens of bungalows. It also occurs, though in smaller numbers, in scrub-jungle and cultivation. The majority of eggs appear to be laid in April, but work on the nest-cavity begins as early as January. During the earlier part of the work of excavation, the birds only work on the warmer days, a cold spell or a shower at once stopping work. Rain at once silences this species, but if there is a break of a few days in the monsoon it recommences calling at once, though not with quite the same energy it shows in the hot weather.

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The Common Cuckoo. *Cuculus canorus* (Linn). ♂ 10-7-28 ; ♂ 30-7-28 ; ♂ 24-6-29.

All three specimens appear to be intermediate between *C. c. canorus* and *C. c. telephonus*, but nearer to the latter than to the former. The status of this species in the neighbourhood of Mhow is somewhat puzzling. It calls vigorously through June and July, chiefly in scrub-jungle in the neighbourhood of the Vindhya Hills, but also to a less extent within the Cantonment itself. I have never heard or seen the species on the plateau north of Mhow. Apart from the two months mentioned, I have only seen it three times, twice in September, and once in November. On each of these three occasions, it was seen just beyond the polo-ground. The *Fauna* (Second edition, Vol. IV, p. 137) says:—'Betham found it breeding in the broken country near Mhow.' General Betham kindly enlarged on this statement in answer to my queries as follows:—'I only twice got an egg of the Cuckoo, both times from the nest of the Black-crested Bunting. One nest was situated on the roadside, where the road had been carved out of the side of the hill, and the other on the ground. These Buntings were very common on the ghat below Simrole.' This did not seem to me quite conclusive, the more so as *Cuculus micropterus* is numerous on 'the ghat below Simrole'; so I shot three Cuckoos and examined their organs. The specimens were all calling vigorously when shot, though the first two were in moult, a condition in which birds do not usually breed. Most species of birds are silent when moulting. In both these cases the organs were somewhat enlarged. The third specimen had just mated with a hen when shot, and almost before the body could be picked up the hen was favourably receiving the attentions of another male Cuckoo. This last specimen was in breeding condition. Both in 1928 and 1929 it was a very common sight in the scrub-jungle immediately south of the Mhow-Simrole Road to see Cuckoos engaged in vigorous courtship. They are so numerous in June and July that the fact that they were only observed three times during the rest of the year, and then not in the locality where they were common in the summer, suggests that they are mainly, if not entirely, summer visitors. The three individuals seen in the autumn may well have been migrating from further north. The note of the Cuckoos round Mhow varies slightly from the note of the Cuckoo in England. In both England and Central India the interval between the two parts of the Cuckoo's call varies, but whereas in England it appears to vary normally between a major and a minor third, in the neighbourhood of Mhow it varies between a minor third and a major second. The variation is not merely between individual birds, but may be noted in the call of the same bird. When beginning to call, the Cuckoo generally employs the larger interval, but when it has been calling continuously for some minutes, it appears to get tired and occasionally employs the smaller interval. Some individuals seem to use the smaller interval almost all the time. The following two quotations bear on the subject of Cuckoos in the Mhow area. 'I have seen it at.....Mhow (where very common in the rains, frequenting bushes on grassy plains).' (Jerdon, Vol. I, p. 322). 'Fairly common on the hills near Mhow at the end of the rains.' (S. & B.)

The Indian Cuckoo. *Cuculus micropterus* (Gould).

Fairly numerous in the Vindhya Hills, calling during June and July. Not recorded at any other season.

The Common Hawk-Cuckoo or Brain-fever-Bird. *Hierococyx varius* (Vahl.).

Fairly numerous in summer. It begins to call shortly before the rains break (June), but only comes into full 'song' after they have broken, and continues to call till well into September. An occasional bird may be heard calling in October. Not noted between October and the end of May, though whether this is due to its migrating or simply to the fact that it is not conspicuous during its silent season, is uncertain.

The Pied Crested Cuckoo. *Clamator jacobinus* (Bodd.)

A rains visitor, sometimes in considerable numbers. Earliest and latest dates seen: June 21 and Oct. 16. In 1928 this species occurred in very large numbers, in 1927 and 1929 in very much smaller numbers. Few seem to arrive before the beginning of July, or to remain after the end of September.

On 5-8-29 a juvenile was seen in an Acacia being fed by a pair of Large Grey Babblers.

The Koel. *Eudynamis scolopaceus* (Linn.).

Mainly a summer visitor, but a few stay throughout the winter. Even in winter it seems to be the first bird to wake up in the morning. It begins to call about the middle of March. It victimises both *Corvus coronoides* and *Corvus splendens*.

The Sirkeer Cuckoo. *Taccocua leschenaulti sirkee* (Gray).

Occasionally seen, chiefly in scrub-jungle. Appears to be resident.

The Coucal or Crow-Pheasant. *Centropus sinensis* (Stephen).

Numerous and resident. It breeds during the rains, and seldom calls at other times. A break of a few days in the rains silences it. The female has a very peculiar call used in courtship. The following is an extract from my diary for September 5:—'When I first saw them (*i.e.* a pair of Crow-Pheasants), they were both on the ground, the cock pursuing the hen, and the latter running with tail depressed and wings drooped. The male then flew into a tree, while the female remained standing on the ground, drooping and vibrating her wings, and constantly repeating a harsh cry—'Ske-e-e-a-aw'. After about two minutes the cock returned, and the hen, after another short pursuit, allowed herself to be captured, and the two mated, one of them giving voice to a low and melodious variation of the usual 'Whoot-whoot' note.

The Large Indian Paroquet. *Psittacula eupatria* (Linn.).

Small flock seen on the outskirts of Mhow 3-11-28, and a single bird on the same spot 15-7-29. No other record.

The Rose-ringed Paroquet. *Psittacula krameri* (Scop.).

Numerous and resident, but moves about locally in relation to food supply. Outside a small temple near Mhow it is the custom of the priest for a few weeks during the rains to put down grain for the paroquets each morning. On these occasions not less than two hundred gather together within a space not more than twenty feet square. No other species of Paroquet was noted feeding there, though it was in the trees just above the temple that the last species was seen. A pair of Jungle Crows occasionally joined the Paroquets at their meal, looking somewhat nervous in the middle of a green carpet of Paroquets. Eggs laid in February and March.

The Blossom-headed Paroquet. *Psittacula cyanocephala* (Linn.). ♀ 28-5-28.

Resident in small numbers, rarely coming near houses. The one specimen obtained was so young that it cannot have left the nest many days. Eggs are, therefore, probably, laid in April.

The Kashmir Roller. *Coracias garrula semenowi* (Loud. & Tschusi). ♀ 22-9-28, ♀ ? 27-9-29.

Numerous on passage about the end of September. Not noted on the spring passage.

The Indian Roller or Blue Jay. *Coracias benghalensis* (Linn.).

Resident. Not as numerous as in most parts of India. Appears to breed in April and again during the rains.

The European Bee-eater. *Merops apiaster* (Linn.).

Several birds which I am convinced belonged to this species, seen at Bircha 24-10-28. Unfortunately, no specimen could be obtained. No other record.

The Common Indian Bee-eater. *Merops orientalis* (Lath.).

Resident in small numbers. Very numerous in autumn and spring. The scarcity of suitable nesting sites probably accounts for the smallness of their numbers in the summer. When courting (about the end of March and

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beginning of April), the cock frequently presents a wasp to the hen. The increase of numbers in the autumn begins towards the end of September, and lasts till about Christmas. The spring passage is less marked.

The Blue-tailed Bee-eater. *Merops superciliosus javanicus* (Horsf.). ♂ 19-8-29.

Appears to be entirely a passage migrant, very much more numerous in autumn than in spring. In spring it passes through Mhow in May. In the autumn it makes a longer stay, having been seen from Aug. 2 to Oct. 2.

The Pied Kingfisher. *Ceryle rudis* (Linn.).

Common over tanks, and occasionally seen fishing on small streams.

The Common Kingfisher. *Alcedo atthis* (Linn.).

Appears to be resident in small numbers. On more than one occasion when this species ventured to fish in a reach where a pair of White-breasted Kingfishers commonly fish for crabs, the latter attacked the former with great fury and drove him off.

The Stork-billed Kingfisher. *Ramphalcyon capensis* (Linn.).

One is generally to be seen over the river opposite the Residency grounds at Indore. S. & B. procured one at the Depalpore Lake.

The White-breasted Kingfisher. *Halcyon smyrnensis* (Linn.).

Numerous and resident, breeding in April. A pair seem to live permanently at the confluence of two small streams just outside Mhow. The streams are generally dry for the last three months before the breaking of the monsoon. So long as there is water in the stream the favourite diet of these Kingfishers seems to be crabs, though they have sometimes been seen to catch fish (*Chitwa*). Their method of dealing with a crab is to beat it to a pulp on a stone or the branch of a tree, and to swallow it whole. Any part that may have fallen off in the beating process, a claw, for example, is carefully retrieved and eaten afterwards. When the stream runs dry they take to a diet of crickets, etc., and in 1928, when water remained in the stream later than it does most years, they gave up fishing at the time they would normally be obliged to. A lady living in Mhow told me that one White-breasted Kingfisher used frequently to come and catch Goldfish from a small pond in her garden.

The Common Grey Hornbill. *Lophoceros birostris* (Scop.).

Appears to be migratory. Occasionally seen in the winter, frequently in spring and autumn, but only once between April 23 and September 16. It generally occurs in flocks of six. On the one occasion when one was seen in the summer, it was a solitary bird seen on June 10 in the Vindhya Hills just below Simrole.

The Hoopoe. *Upupa epops* (Linn.).

Resident in small numbers. Breeds in April and May. Its numbers are greatly increased in winter. The breeding birds, from their bright, chestnut colouring and the fact that there is no white between the chestnut of the head and the black of the crest I take to be *U. epops orientalis*. Many of the winter birds are paler in colour, and have a good deal of white in the crest. Unfortunately, no specimens were obtained.

The Alpine Swift. *Micropus melba* (Linn.).

A passage migrant, fairly numerous over tanks in February and March, and again in September.

The House Swift. *Micropus affinis* (Gray).

The chief breeding season is in April. Some stay for the winter, and appear to breed then, but the majority seem to leave Mhow about the end of October, returning at the beginning of March.

The Crested Swift. *Hemiprocne coronata* (Tickell).

General Betham in a letter, referring to Simrole, writes :—' The Crested Swift also hangs out there, but I was never fortunate enough to get eggs.' Lt. Young (*J. B. N. H. S.*, Vol. XVI, p. 514) states that he saw the species in the Nabadda Valley in March and April. I have no record of the species.

Franklin's Nightjar. *Caprimulgus monticolus monticolus* (Franklin). ♀ 6-8-28.

A summer visitor. They appear to arrive in April and leave about the end of August. The one place where, between those two months, one can always be certain of seeing this species is the channel for taking the overflow water from Bircha Lake. In July and August they occur there in flocks of eight or more. The only other place in the neighbourhood of Mhow where I have seen them is in scrub-jungle south of the Mhow-Simrole Road, where I put one up off two fresh eggs on 1-7-29.

The Common Indian Nightjar, *Caprimulgus asiaticus* (Lath.). ♂ 16-11-27; ♀ 22-6-28.

Fairly numerous in scrub-jungle, and occurs, though in smaller numbers, within the Cantonment. In summer after dark they frequently sit in the middle of the road, where it passes through scrub-jungle, and their large eyes reflect the lights of approaching cars long before their bodies become visible. Eggs laid in the latter half of June.

The Indian Barn-Owl. *Tyto alba javanica* (Gmel.).

Juvenile bird in captivity, which had been taken from a nest in the roof of occupied barracks some three months earlier, seen 25-12-27.

The only other record of the species is of one which came out of the Bagh Caves, about eighty miles W. S.-W. of Mhow, 23-4-29.

The Dusky Horned Owl. *Bubo coromandus coromandus* (Lath.).

Occasionally seen.

The Indian Spotted Owlet. *Athene brama* (Temm.).

Numerous and resident. Breeds in April.

The Osprey. *Pandion haliaëtus* (Linn.).

One fishing in Bircha Lake, 16-9-27. No other record.

Cinereous Vulture. *Egyplus monachus* (Linn.).

'I saw it . . . also at Mhow.' (Jerdon, Vol. I, p. 7.)

The Black Vulture. *Sarcogyps calvus* (Scop.).

One pair, never more, seen in almost every collection of vultures round a carcass.

The Indian Long-billed Vulture. *Gyps indicus* (Scop.).

More numerous than the last species, less so than the next.

The Indian White-backed Vulture. *Pseudogyps bengalensis* (Gmel.).

Resident and very numerous as a rule. All the last three species, however, deserted the district in June 1927, and only came back gradually in the autumn. The time they deserted the neighbourhood of Mhow was the time of heavy and destructive floods in Gujerat and Kathiawar, when there must have been an unusual quantity of food suitable for vultures in those parts. Whether there was any connection, it is impossible to say.

The Neophron or Scavenger Vulture. *Neophron percnopterus* (Linn.).

Common and Resident. Lt. Young found that in the Nabadda Valley in April there were nests of this species containing eggs on 'almost every suitable piece of cliff'. (*J. B. N. H. S.*, Vol. XVI, p. 515).

The Indian Tawny Eagle. *Aquila rapax vindhiana* (Frank.).

Resident, but not very numerous. Breeds in March. This species is frequently mobbed by kites.

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The White-eyed Buzzard-Eagle. *Buteo teesa* (Frankl.) 0? 5-10-28; 0? 20-10-29.

Not very numerous, but appears to be resident. Lt. Young found a nest of this species containing one egg in the Narbadda Valley on April 5. (*J.B.N.H.S.*, Vol. XVI, p. 515).

The Pariah Kite. *Milvus migrans govinda* (Sykes).

Numerous and resident. This species seems to have a strong dislike for the Indian Tawny Eagle, and it is a common sight to see one of the latter being mobbed by kites. Eggs are laid in January and February, but kites may often be seen carrying sticks up into trees about the end of September. As the weather becomes colder, they cease from this practice, and do no more work on their nests till January.

The Black-winged Kite. *Elanus caeruleus* (Desf.).

S. & B. report having shot one at Mhow on September 25, and two at the Delapore Lake in December and January respectively.

The Pale Harrier. *Circus macrourus* (S. G. Gmel.).

Fairly numerous in winter. One was seen at Bircha as early as August 2, and again on August 9, but the majority do not appear to arrive before the end of September or the beginning of October.

The Marsh Harrier. *Circus æruginosus* (Linn.). ♀ 17-9-28.

This is the commonest of the harriers round Mhow, being particularly numerous in September and April. The stomach of the above-cited specimen contained the whole of a lark, apparently *Galerida deva*, with the exception of the head. It is seen in equal numbers over the swampy margins of *jhils*, cultivation, and dry pasture land.

The Indian Shikra. *Astur badius dussumleri* (Temm.). 0? 12-10-27; ♂ 15-10-28.

Fairly common, more so in winter than in summer. The former of the above-mentioned specimens contained a snake $4\frac{1}{2}$ " long, a large, striped wasp, a very large beetle, and the remains of several fresh-water crabs.

The Besra Sparrow-Hawk. *Accipiter virgatus* (Temm.).

S. & B. Obtained two specimens at Mhow in October 1881. They saw no others.

The Shahn Falcon. *Falco peregrinus peregrinator* (Sund.).

Said by Jerdon to breed 'at the great waterfall at Mhow'. (Jerdon, Vol. I, p. 27). Presumably the waterfall referred to is that at Patalpani, about three miles out of Mhow. A pair of this species were circling round over it when I visited it on March 19, and on the face of the cliff on the side of the gorge opposite the fall, there was a site which had obviously been used for an eyrie for very many years. I did not observe the species elsewhere in the neighbourhood of Mhow. S. & B. state that a pair of this species frequented the same waterfall during the cold season of 1881.

The Lager Falcon. *Falco jugger* (Gray).

Occasionally seen.

The Red-headed Merlin or Turumfi. *Falco chiquera* (Dauden).

Occasionally seen, generally in pairs.

The Kestrel. *Falco tinnunculus* (Linn.). ♀ 24-2-28; ♂ 3-10-28; ♀ 9-2-29.

A winter visitor in considerable numbers. Earliest and latest dates recorded, September 22 and April 2. Crickets form a large part of their diet and they also seem to be partial to centipedes.

The Common Green Pigeon. *Crocopus phœnicopterus* (Lath.).

Appears to be resident, but not in very great numbers. More often seen on the outskirts of jungle along the Simrole Road than anywhere else. Lt. Young found their eggs in the Narbadda Valley on March 28 and April 6. (*J. B. N. H. S.*, Vol. XVI, p. 514).

The Blue Rock-Pigeon. *Columba livia* (Gmel.).

Not as numerous as in many parts of India, possibly owing to the paucity of buildings suitable for nesting-sites. They appear to have no regular breeding season. One or more pairs were engaged in domestic duties in the tower of my church during most of the year.

The Indian Rufous Turtle-Dove. *Streptopelia orientalis meena* (Sykes).

'Very common at and near Mhow.' (S. and B.) I did not observe the species.

The Spotted Dove. *Streptopelia chinensis* (Scop.).

Resident, but more numerous in summer than in winter. Early in the rains it gathers into flocks up to about a dozen strong. About November the flocks disappear, and the numbers diminish.

The Brown Turtle-Dove. *Streptopelia senegalensis* (Linn.).

The commonest dove in the neighbourhood of Mhow. Breeds chiefly from March to May, and again, in smaller numbers, from September to November, i.e., before and after the rains.

The Indian Ring-Dove. *Streptopelia decaocto* (Frivaldsky).

Almost as numerous as the last species. Appears to breed at all seasons. In winter gathers into small flocks.

**The Indian Red Turtle-Dove. *Enopopelia tranquebarica tranquebarica* (Henry).
♂ 21-9-27.**

The least common of the doves about Mhow. It is mainly a summer visitor, only rarely being seen in winter; nest containing one egg found 30-3-29.

The Painted Sandgrouse. *Pterocles indicus* (Gmel.).

Resident, but more numerous in winter than in summer. On three occasions in July a pair were put up in scrub-jungle. Lt. Young took the eggs of this species on March 28 in the Narbadda Valley. (*J.B.N.H.S.*, Vol. XVI, p. 514). This suggests that the close season, which at present begins in Central India on April 1, might with advantage be put earlier.

The Coronetted Sandgrouse. *Pterocles coronatus atratus* (Hartert).

'Swinhoe obtained three specimens from Mhow in Dhar.' (*Fauna*, Vol. V., p. 268.)

The Common Sandgrouse. *Pterocles exustus* (Temm.).

Fairly common, particularly so in April. Jerdon says of this species, 'At Mhow—most of them leave the district after breeding in July and do not return till the end of the rains.' (Jerdon, Vol. II, p. 503).

The Peacock. *Pavo cristatus* Linn.

Never seen in cultivation, and not very common in jungle, as the species has been shot a great deal in the neighbourhood of Mhow. In 1928 a law was passed by the Indore Durbar making it illegal to shoot this species in Indore State. If this law is enforced, Peacocks may be expected to become very much more common.

The Red Spur-Fowl. *Galliperdix spadicea* (Gmel.).

'Seen in Vindhya Range.' (Jerdon, Vol. II, p. 542).

The Blue-breasted Quail. *Excalfactoria chinensis* (Linn.).

One seen about five miles south of Mhow, 8-5-29.

The Common Quail. *Coturnix coturnix* (Linn.).

Fairly numerous in the winter.

The Rain Quail. *Coturnix coromandelica* (Gmel.).

Not so numerous as the last species. Not observed in the summer.

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The Jungle Bush-Quail. *Perdica asiatica* (Lath.).

Very numerous in scrub-jungle in spring and summer. Less numerous in winter.

The Rock Bush-Quail. *Perdica argoondah* (Sykes).

Appears to be resident in small numbers, and sometimes occurs in the same covey with the last species.

The Painted Bush-Quail. *Cryptoplecton erythrorhynchum* (Sykes).

A pair seen near Dunga gaon, about two miles from Mhow, 21-8-28.

The Painted Partridge. *Francolinus pictus* (Jard. and Selby).

Numerous in long grass, crops, and rushes.

The Grey Partridge. *Francolinus pondicerianus* (Gmel.).

Not so numerous as the last species, and keeps to drier ground as a rule.

The White-breasted Waterhen. *Amaurornis phoenicura* (Pennant).

Numerous on the river at Indore. The only other record is of one bird, possibly the same individual each time, which was always to be found by the Ghambier River just beyond the Mhow golf links in March 1928 and 1929.

The Brown Crake. *Amaurornis akool* (Sykes).

One was found sitting on six eggs in a nest built in a collection of flood-wrack in the top of a stunted Acacia on the bank of the Ghambier River, on Sept. 2. The nest was about four feet above the ground and about ten feet above the surface of the water. The bird sat very close, and used to allow me to watch her from a range of about three feet. This is probably the same bird that I had seen, without being able to identify it, skulking about by the stream at this point on a good many other occasions. The species was not observed elsewhere.

The Moorhen. *Gallinula chloropus* (Linn.).

Numerous on the river at Indore. Once or twice seen on the Ghambier River.

The Common Coot. *Fulica atra atra* (Linn.).

Very numerous on some tanks, and entirely absent from others apparently as suitable.

The Sarus. *Megalornis antigone* (Linn.).

Numerous at all seasons in all types of country except jungle. It is an irregular breeder, but by far the majority of eggs are laid in September.

The Likh or Florican. *Sypheotides indica* (Gmel.).

Mainly a rains visitor in varying numbers. It was more numerous in 1928 than in 1927 or 1929. Eggs laid in August. 'Common during the rains, at which season it breeds but some of them remain in the neighbourhood of Mhow throughout the year.' (S. and R.)

The Stone-Curlew. *Burhinus oedipnemus* (Linn.). ♂ 13-2-28.

Seen occasionally, always on rocky hillside covered with a growth of young 'country teak', except once when several were feeding in swampy ground by the Bircha overflow.

The Indian Courser. *Cursorius coromandellicus* (Gmel.). ♂ 11-5-28.

Status doubtful. Frequently not seen for weeks together, while at other times it occurs in great numbers. Very large flocks seen near the 13th milestone on the Mhow-Neemuch Road on November 5 and 12, 1928.

The Pheasant-tailed Jacana. *Hydrophasianus chirurgus* (Scop.).

This species seems to be mainly, if not entirely, a spring and autumn visitor to the immediate neighbourhood of Mhow. It is very numerous on the shores of Bircha Lake during May. On 13-9-29, they were breeding in large numbers on the various tanks at Mandu, some sixty miles away.

The Red-wattled Lapwing. *Lobivanellus indicus* (Bodd.).

Very numerous and resident. Local name *Tituri*. The majority of eggs appear to be laid in May, but they may also be found in June and July, and probably in other months as well. All the 'nests' I saw in May, consisted of a depression in the ground, unlined, and fairly near water. A nest found on July 16, 1928, was, however, of a different type, and a description of it also covers several nests found after the breaking of the rains in the following year. It was situated on the top of a grassy mound, about ten yards from a stream, and the eggs reposed on a bed of gravel, evidently brought from the bed of the stream by the birds themselves. As the monsoon had broken about a month before, and rain was to be expected daily while the eggs were incubating, this arrangement seems to have been designed to provide drainage. For a bird that does no more normally than to make a scrape in the ground, to take special measures to meet special weather-circumstances, suggests a fairly high order of intelligence.

The Yellow-wattled Lapwing. *Sarciornis malabaricus* (Bodd.). ♀ 23-3-28.

Local name *Lauri*. Status uncertain, but it certainly breeds in the neighbourhood. Seen occasionally on barren ground, chiefly in spring and summer.

The Sociable Plover. *Chettusia gregaria* (Pall.).

'Seen at Mhow.' (Jerdon, Vol. II, p. 645).

The White-tailed Lapwing. *Chettusia leucura* (Licht.).

A small flock of birds which appeared to me to belong to this species were feeding near the Towers of Silence on the evening of May 26. I watched them for some time through field-glasses from a distance of from 150 to 200 yards. They were very shy, however, and would not allow me to approach within reasonable range to obtain a specimen.

Jerdon's Little Ringed Plover. *Charadrius dubius jerdoni* (Legge). ♀ (juv.) 16-7-28
Occasionally seen at Bircha in April and the rains. A pair seen there 22-4-27 were behaving as if they had eggs or young. Lt. Young found their eggs in the Narbadda Valley on May 5. (*J.B.N.H.S.*, Vol. XV, p. 514.)

The Black-winged Stilt. *Himantopus himantopus* (Linn.).

Common in winter, generally in pairs, but sometimes in flocks up to about twenty. Contrary to general belief, these birds are by no means bad eating.

The Common Sandpiper. *Tringa hypoleuca* (Linn.).

A winter visitor in small numbers.

The Wood-Sandpiper. *Tringa glareola* (Linn.).

Occasionally seen in winter.

The Green Sandpiper. *Tringa ochropus* (Linn.). ♂ 26-10-27; ♀ 15-8-28; ♀ (juv. by oviduct) 2-7-29.

A very numerous winter visitor. From September to April at least one is to be seen by every stagnant pool, and several along the margin of every *phil*. In April they tend to gather into flocks, and their numbers are increased by the addition of birds on passage from further south. The last species sometimes mixes in these flocks. The majority have left by the end of April, but a few individuals, presumably non-breeders stay for the whole summer. By the middle of July their numbers begin to increase. A pair watched on March 2, were courting. One was displaying and the other apparently inviting his attentions. The former kept up a call quite unlike the usual call of the species, sounding rather like two flints being knocked together.

The Spotted Redshank. *Tringa erythropus* (Pall.). ♂, Manpur, 20-10-28.
Occasionally seen, always solitary, in winter.**The Redshank. *Tringa totanus* (Linn.).**

A winter visitor in small numbers, occurring singly and in pairs.

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The Greenshank. *Tringa nebularia* (Gunner). ♂ 19-11-28.

A winter visitor in larger numbers than either of the last species, usually seen in pairs.

The Little Stint. *Erolia minuta* (Leisler).

Occasionally seen in winter, and more frequently in March and April. Earliest date seen, Aug. 3.

Temminck's Stint. *Erolia temminckii* (Leisler). ♀ 9-5-28; ♀ 27-4-29.

More numerous than the last species, especially in April and May. During the winter they occur in small parties of about five, but towards the end of the season in pairs, which may often be seen courting.

Fantail Snipe. *Capella gallinago gallinago* (Linn.).

Fairly numerous in the winter.

The Pintail Snipe. *Capella stenura* (Bonaparte).

A winter visitor. I have been told that in the neighbourhood of Mhow the last species is more numerous from September to November, and the present species after November, but I cannot vouch for this personally.

The Painted Snipe. *Rostratula benghalensis* (Linn.).

Resident and fairly numerous, but subject to local movement as the swamps dry up.

The Black-headed Gull. *Larus ridibundus* (Linn.).

One seen over a tank about fifteen miles from Mhow, 26-11-28. No other record.

The Indian River Tern. *Sterna seena* (Sykes).

Fairly common over tanks in winter. Lt. Young saw a young bird of this species near Mhow on May 15. (*J.B.N.H.S.*, Vol. XVI, p. 516).

The Black-bellied Tern. *Sterna melanogaster*. (Temm.).

Also seen in winter, but less commonly than the last species.

The Indian Shag. *Phalacrocorax fuscicollis* (Steph.).

Resident in all suitable localities.

The Little Cormorant. *Phalacrocorax javanicus* (Horsfield).

Appears to be resident, but by no means so common as the last species.

The Indian Darter or Snake-Bird. *Anhinga melanogaster* (Pennant).

A pair to be seen on almost every tank at all seasons.

The White Ibis. *Threskiornis melanocephala* (Latham).

One seen by tank fifteen miles west of Mhow, 12-11-28, and one by the Narbadda at Barwani, 24-4-29.

The Spoonbill. *Platalea leucorodia* (Linn.).

Two or three at Barwani by the Narbadda River, 24-4-29.

The White Stork. *Ciconia ciconia* Linn.

Two or three by the Narbadda River at Barwani, 24-4-29.

The White-necked Stork. *Dissoura episcopa* (Bodd.).

Resident in small numbers.

The Black-necked Stork. *Xenorynchus asiaticus* (Lath.).

Occasionally seen.

The Open-bill. *Anastomus oscitans* (Bodd.).

Several by the Narbadda at Barwani, 24-4-29.

The Purple Heron. *Ardea purpurea* (Linn.).

One on island in Jeshwantnagar Lake, 20-8-28.

The Grey Heron. *Ardea cinerea* (Linn.).

Seen at all seasons, but most numerous in winter.

The Large Egret. *Egretta alba* (Linn.).

A pair seen over a tank about thirteen miles west of Mhow, 5-11-28. Not identified with certainty on any other occasion.

The Little Egret. *Egretta garzetta* (Linn.).

Fairly common at all seasons.

The Cattle Egret. *Bubulcus ibis*. (Linn.).

Occurs at all seasons, but a great increase in numbers takes place the day after the first rain of the monsoon falls. In the immediate neighbourhood of Mhow I have not found any colonies breeding, though in May I have seen them carrying sticks. Two nests in a tree on the platform of Rutlam Railway Station contained two and three fully-fledged young respectively on 3-8-28.

The Reef-Heron. *Demigretta sacra* (Gmelin.).

One seen flying high and steadily from the west about 7-30 a.m. on 8-10-29. On coming over the polo-ground it circled down and joined a party of Cattle Egrets which were feeding there. After feeding with them for about five minutes it flew off steadily due east, rising as long as I could see it.

The Pond Heron. *Ardeola grayii* (Sykes).

Common at all seasons wherever there is water.

The Night-Heron. *Nycticorax nycticorax nycticorax* (Linn.).

One seen by the Ghambier River, about five miles from Mhow, 23-9-29.

The Common Flamingo. *Phoenicopterus ruber* (Linn.).

One seen by the Narbadda, near Barwani, 24-4-29.

The Cotton Teal. *Nettapus coromandelianus* (Blanf. & Oates).

Seen occasionally on Bircha Lake, at Dhar, and Mandu. At the latter place they appeared to be breeding, 13-9-29.

The Bar-headed Goose. *Anser indicus* (Leatham).

One seen on a tank about thirteen miles west of Mhow, 5-11-28.

The Lesser Whistling Teal. *Dendrocygna javanica* (Horsf.).

Numerous at Bircha during the early part of the rains. Occasionally seen there and at Jeshwantnagar up to the end of September.

The Ruddy Sheldrake or Brahminy Duck. *Casarca ferruginea* (Vroeg.).

Not uncommon on the Narbadda in winter. Mr. M. Young reports having seen them there as late as April 14. (*J.B.N.H.S.*, Vol. XIV, p. 515.)

The Mallard. *Anas platyrhynchos* (Linn.).

A winter visitor in varying numbers. It was more numerous than usual in the winter of 1928-29, which was an abnormally cold winter over the whole of Northern India.

The Gadwall. *Chaulelasmus streperus* (Linn.).

A very numerous winter visitor.

The Common Teal. *Nettion crecca* (Linn.).

The most numerous member of the family in winter. Earliest date recorded, Sept. 16.

The Garganey or Blue-winged Teal. *Querquedula querquedula* (Linn.).

Occurs in winter, but is more numerous in the spring. Latest date seen, May 9.

The Shoveller. *Spatula clypeata* (Linn.).

Not uncommon in the winter. Mr. M. Young says:—'I saw one flock of seven Shovellers (*Spatula clypeata*) on April 14, and shot one which was quite good eating.' (*J.B.N.H.S.*, Vol. XVI, p. 515.)

The Little Grebe or Dabchick. *Podiceps ruficollis*. (Vroeg.).

Resident in small numbers on permanent water. Never seen on tanks that dry up.

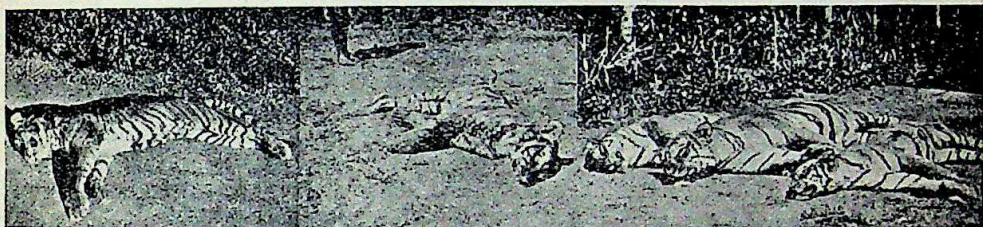
A TALE OF FIVE TIGER

BY

R. C. MORRIS, F.Z.S., F.R.G.S.

(With a photo).

On the 23rd January news came in of a tiger kill some 15 miles away. I was not long in getting away in my Ford van, and was in my machan by 5 p.m. Only a mouthful had been eaten of the kill. The kill was a cow I had tied up on a path



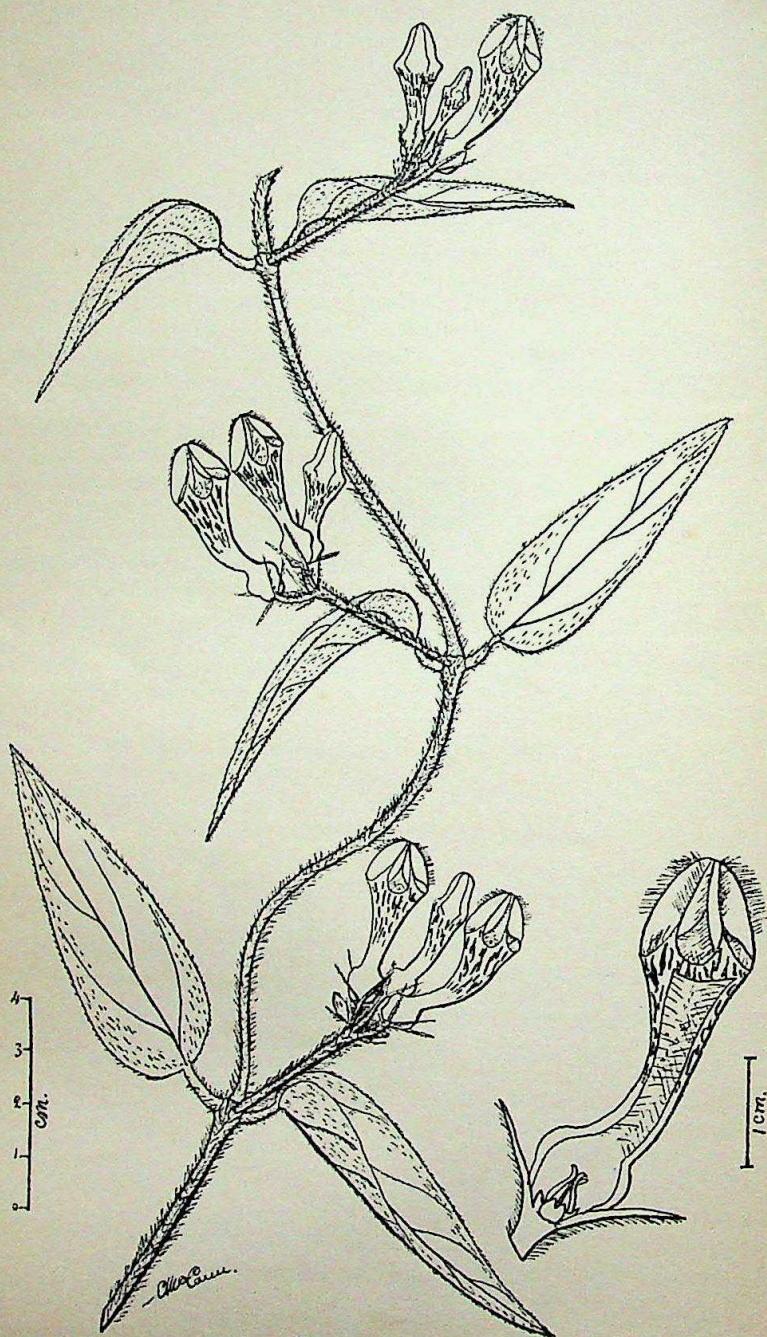
running through dense forest, on the borders of a stream, in the hopes of bagging a large tiger that had been prowling around these parts for some time, and calling—the grand “Ar-r-o-ung”—as he roamed the country side. The kill was almost certainly his. At 6 p.m. monkeys could be heard swearing in the trees someway behind me, and 30 minutes later a low moan from a tiger. At about 7 p.m. an animal galloped passed behind me, crashing heavily through the undergrowth, followed a few seconds later by another. I soon realised that they were tiger and it was not long before the jungle around seemed to be full of tiger, trampling all over the place. At just about 7-30 p.m. I heard more than one tiger approach the kill and start feeding. I turned on my torch (a 2-cell Ever-Ready, clamped to my rifle) and five tiger were revealed grouped round the kill, the largest, a monster, furthest to the right. Before I could fire the big tiger stepped back into the shadows and I took the next in size, a tigress, and rolled her over. The remainder scattered, I switched off the light, and dead silence supervened for about three or four minutes—then I heard a tiger moving on my left, and another on my right, and a few seconds later I heard another move across my front near the kill. I quickly lit up the kill, shot a smaller tigress just before she entered the darkness to the right of the kill (she disappeared as I fired), and switched off again. Once more dead silence, and a little later I heard a tiger on my right walk heavily away, and another on my left walked round (behind my machan) to my right. Then the former, undoubtedly the big tiger, that had walked away, started calling his great, organ-like “Ar-r-o-ung” sending the notes crashing out into the stillness of the night with a startling suddenness.

The calls, at intervals of about 10 seconds, were kept up from then on till 4-30 a.m., except for two intervals when the tiger returned to the scene of slaughter and licked the large dead tigress, which was lying out of view, to my right. On each occasion he spoke his mind to one of the other two tiger, which I fancy was standing near the dead tigress, and a great rumpus there was too, coughing roars, and giant cat-like spits and snarls—and then away out into the far distance he wandered off again calling, his calls sounding fainter as he went further away and louder again as he came round on his detour. Now and again, as he drew near, he would halt and vary his call to a short “Ar-r, Ar-r”, and then the deep “Ar-r-o-ung”. At about 4-30 a.m. he came to the dead tigress for the third time, now calling, and the air seemed to quiver as the grand volume of sound reverberated through the surrounding jungle. As he reached the tigress, a few paces from the kill, he stopped, and all sound ceased. The sudden cessation of sound was weird in the extreme, there was not a breath of wind, and the very insects in the jungle seemed to participate in maintaining a heavy and oppressive silence. I could distinctly hear the tiger breathing, and the firm tread of one of the other tigers could be heard in the jungle behind me, while some way off the fifth tiger commenced to call plaintively. This silence lasted for about half an hour, the tiger listening intently. I heard no sound to indicate that the tiger had moved from his position, and jumped perceptibly when the kill was suddenly jerked, and this was followed by a great tearing of flesh and sounds typical of the big cat indulging in a hearty meal. I waited for a minute or two and then switched on the light—a huge tiger lay at full length at the tail end of, and at right angles to, the kill. He lifted his great head and stared up at me and next moment was roaring and rolling on the ground mortally wounded. Before I could fire again he disappeared, crashing into the darkness for about 50 yards, and then came deep gurgling sobs, and—silence. I lay back against the back rail of my machan with a feeling of relief and a queer feeling also that I had undergone a certain amount of strain. Dawn brought with it all the usual awakening noises of the jungle, and there was very little to show, sitting where I was in the machan, that anything had happened during the night—the kill was in the same position, very little more had been eaten from it, and no sign of the three tiger I had shot. I was also not sure that the smaller tigress I had fired at was dead. I called to my men who were in some fields not far off—and descended from my machan. As I approached the kill I saw the larger tigress lying dead a few paces down the path the old tiger was wont to travel along. I walked down the path a few yards beyond and I saw the smaller tigress lying dead three or four feet off the path. I returned to the kill and advanced cautiously along the tracks of the old tiger, which had lurched off in the opposite direction, and to my delight, found him lying stone dead about 50 yards away. This was great, and the joy of my shikaries can be realised. A dozen villagers were soon got together and the three tiger were carried to my Ford van, where they were placed side by side—an

imposing spectacle! They measured 9 ft. 10 in., 8 ft. 7 in. and 7 ft. 5 in. The shikaries' opinion that the kill was the work of the old tiger, probably at dawn, which would account for his not having eaten more, and that the other four happened to join him by chance, was shared by me.

To continue, I sat up again the following night in the hopes of seeing the two surviving tiger on the kill, but although I heard at least one of them moving about they did not approach the kill. The following night saw me motoring on the road again to sit up for the third time. I had perforce to start very late, and it was dark before I had got half way. When nearing the eventful spot as the car swung round a corner, the headlights showed a tiger advancing up the road. In a moment the tiger had disappeared below the road, and I slowly brought the car to a standstill at the spot where it was seen to disappear. I quickly strapped to my fore-head an electric Inspection Lamp I had in the car, and leaning out over the side I found myself looking into the tiger's eyes at a distance of about ten or twelve feet. I had already loaded my rifle, and slowly bringing it up to my shoulder and aiming between its eyes I fired. The tiger rolled over with a roar, and then rushed off without giving me a chance of putting in a second shot. It was pitch dark, and following up the tiger then was out of the question. I was down on the spot next morning with my trackers and two dogs; and immediately picked up a handful of teeth and bits of bone, which indicated that my bullet had smashed the poor brute's lower jaw. We followed the blood tracks down the hill-side to a ravine and up the further slope. It was soon apparent that the tiger had avoided all thick cover, and made a detour round every bush and thicket. By midday we could find no further blood tracks, and after searching two small nullas we decided to make straight for a large shady stream—a most likely place for a wounded tiger to choose. Sure enough we found fresh tracks on the dry sand; but after following the bed for a short distance the tracks led out of the nulla again, and were lost. It was now late, and nothing further could be done for the day. I was down again early next morning, and very soon fresh tracks were picked up in the nulla. The tracks entered the nulla down a narrow game path leading out of dense *Lantana* and "Sigie" thorn, followed down the bed for some way, and led up into similar thick cover on the other side. Cautiously following up the tracks we emerged into short grass and on the hard ground the tracks were again lost. Returning to the nulla we effaced all traces of tracks on the sand, and I had just decided to sit up over the nulla that night hoping to see the tiger come along when news of a fresh kill nearby was brought to me, a natural one. I immediately visited the scene of the kill, had a machan put up, and shot the fifth of the group, a young tigress, (7'10") at 7-30 p.m. Next morning fresh tracks were found on the sand in the nulla higher up, but again we could not discover where they led to. For the next three days this was repeated: fresh tracks were to be seen every morning; but the tiger could not be located. He would enter and leave the nulla by one or other of the several game tracks—through the almost impenetrable cover on either side, but it was

impossible to tell where he was lying up; and the dogs were not of much help. The use of cattle was out of the question in this type of cover. On the following day, however, our luck changed. I had sat up all night over the nulla with no result as usual, and now wandered up the stream searching for fresh tracks and found them; but this time *moist* tracks on the dry sand: it was evident that the tiger had been down to water only a short while before. The tracks led up one of the paths into the dense cover and the fresh wet pug marks could not be missed. I had advanced up the path for about fifteen yards when a low hiss from my tracker who was about five yards behind me brought me crawling back to his side, and following the direction of his pointing finger, I saw the tiger lying tail on, about four yards off. Taking quick aim at the root of its spine I fired, and immediately the tiger was in its death throes. Its struggles carried it another six or seven feet further into the cover, where it lay almost hidden from view. Advancing on my hands and knees cautiously I put in another shot when I found myself in a position to see the tiger well. The tiger was already dead however, and we hacked our way through the cover to its side. As was to be expected the poor animal was in a terrible condition, the lower jaw had been completely blown away, and the wound and mouth were a mass of maggots. The tongue was intact, so presumably the tiger had been able to drink: but it made me sick to feel that the wretched animal had been in this condition for a week. It was a great relief to get it, and its death brought to a close a most unusual tiger episode—the visit to a kill of five tiger and the bagging of all five eventually. The last tiger was a male, measuring 8'.



Ceropegia hispida, Blatter & McCann, sp. nov.

ANOTHER NEW *CEROPEGIA* FROM THE WESTERN GHATS.

BY

E. BLATTER, S.J., PH.D., F.L.S., AND C. McCANN, F.L.S.

(With a Plate).

Ceropegia hispida Blatter & McCann, *sp. nov.*

[*Asclepiadacea accedit ad C. elegantem* Wall. *sed differt caule, petiolis, foliis, pedunculo necnon pedicellis dense hispidis vel hirsutis, petiolis fortibus, corollae lobis subobovatis, sepalis subulatis dense hirsutis.*]

Suffruticose. Root tuberous, 3 cm. long. Stem twining, 1.5 m. long, slender, green tinged with black or purple, densely hispid, especially the younger parts. Leaves up to 12 cm. long, 4 cm. broad at base, ovate-lanceolate, acute to acuminate, rounded or subcordate at base, membranous, margins ciliate, upper surface hirsute from slightly bulbous bases, lower surface with scattered hairs and strongly hirsute on the nerves, nerves depressed above, prominent beneath. Petiole 15 mm. long, hirsute, channelled above, a few glands above the petiole on base of leaf. Flowers 1-5 in umbellate cymes. Peduncle arising from between the petioles, 2.5-3 cm. long, purple, densely hispid; pedicels 1 cm. long, densely hispid; bracts subulate, hirsute, 7 mm. long. Calyx 5-partite, divided to the base; sepals subulate, densely hirsute outside, 9 mm. long. Corolla pale green mottled with long vertical purple lines in the upper half below the lobes, 4 cm. long, with a large hemispherical head 12 mm. diam.; tube inflated globose at base, glabrous, curved, enlarged at the mouth, ciliate inside with the exception of the inflated portion; lobes 11 mm. long, subobovate, 10 mm. broad at the widest part, connate almost halfway down, yellow-green with the margins purple, midrib of ventral side ciliate with long purple hairs in the upper half only. Outer corona-lobes shortly horizontally oblong in the basal part, apex deeply bifid, teeth sharply deltoid, with silky hairs outside and inside; inner corona-lobes 4 mm. long without the hook, cylindric, strongly hooked. Fruit not seen.

Locality: Western Ghats: Panchgani, near Godauli (McCann and Fernandez (No. 3566, type).

Flowered 6th Oct., 1930.

SEA-FISHING ON THE BOMBAY COAST

BY

H. C. MUELLER, D.SC.

Public attention has lately been redrawn to the fishing problem of the Western Coast, by the activity of the Bombay Natural History Society. Urgent work is necessary: enormous treasures are to be lifted from the sea to provide a large maritime population with a cheap and valuable food. The sea is abundant with edible fish; the Indian peoples need a cheap and nourishing food; they are to a great extent fish-eaters. To-day's supply of sea fishes in the Bombay Presidency is insufficient, and the preservation of fishes for inland transport is most primitive and inefficient. Everybody—from Government to the fishermen—seems to be anxious to improve matters. In short, the conditions are favourable and the interest sufficient so that with concentrated energy and some skill most satisfying results should be obtainable in a short time.

The Bombay Government have already made a bold step in carrying out trawler-fishing along our coast by the "*William Carrick*". Admittedly, as yet, no practical result has come out from this experiment; but the information gained by the "*William Carrick*" will be of enormous value when once the fishing industry in the Bombay Presidency is developed, and moreover, the work of the "*William Carrick*" has in my opinion shown the way in which the fishing industry should be developed: not by trawler-fishing which, through its fuel consumption and expenses for a European crew, cannot compete with local fishermen and which in supplying the market from time to time only with quantities of fishes, needs first of all a preservation plant and a specially organised market.

The development should come from and with the local fishermen who are well able to increase their catches and work efficiently if they are taught the right way how to do it.

I have watched the fishermen in Chimbai-Bandra and gone out with them for fishing. Chimbai supplies the Bandra and Bombay market with fresh fishes and dries a certain amount of Bombay Duck, Ribbonfishes (*Waghti*, *Trichiurus*) and cut Rays for the up-country and foreign trade. I think I can assume that the situation in other parts of the Bombay Presidency Coast is similar to that in Chimbai with the exception that greater difficulties for marketing are to be faced.

The bottom of the sea off Bombay Island is a gradually deepening flat, covered with a very soft mud until a distance from shore of about ten sea-miles and a depth of about ten fathoms is reached. Beyond this the bottom of the sea continues to deepen gradually but the mud apparently loses somewhat of its great softness.

After the monsoon each community of the fishing villages in Bombay Island prepares three fishing grounds. The farthest is about eight to ten sea-miles from the coast with a maximum depth of

ten fathoms. The nearest ground is in about five fathoms deep and the third lies halfway between the two others. The fishing grounds consist of two anchored buoys for each boat, the buoys all lying in a row at an angle to the tidal currents which flow North to South and South to North, parallel with the coast. The currents are strong and make a good anchoring of the buoys necessary.

This anchoring in the very soft mud is done by inserting long stakes into the mud, sometimes as much as thirty feet deep. The stakes either stick out of the water—in the grounds where the water is shallower—or the iron shoes at the bottom of the poles are left in the mud and the pole itself removed.

There is generally one catch per day by each boat—mostly at night—so that the catch does not suffer from the heat and the sun of the day while bringing it to shore.

The net, consisting of two wings and a bag in the centre is tied to the two stakes at the time of change of tide, just when the current of the water reverses. The net opens through the current and rests at the bottom of the sea. Before the tide changes again, the men commence to pull in the net which takes sometimes one hour and the catch is sailed or rowed home for the market.

The water was rich with plankton in October 1930 and there was a phosphorescence of the sea such as I have never seen elsewhere. We could see the net at a depth of about 9 fathoms as an indistinct silver cloud, the light coming from plankton, thrown against the net and the ropes in great quantities.

There is an absence of any mechanical devices on the fisher-boats. A small winch for instance, made by the village blacksmith would facilitate and quicken the heaving in of the net and of the second buoy before fixing the net and possibly save one hand in each boat.

The fishermen struck me as hard working, robust, cheerful and open minded.

The sailing (or rowing) from the fishing grounds to the villages takes from three to ten hours, on the average about 6 to 8 hours and it often happens that through the delays by western winds or lack of wind in the morning, the fishes suffer before they can be landed.

At times when tides are low, the catch is very poor and many boats do not go out. Apparently, the fishes avoid shallow waters and keep at a certain depth changing the places with the height of water. The fixed fishing grounds prove a great handicap here and more so the inability of the fishermen to establish their fishing grounds in deeper waters. The anchoring stakes are long and heavy and have to be manipulated by hand from between two boats. Longer poles for greater depths are out of question for the fishermen, as long as they do not have heavier boats and mechanical devices at their disposal.

The "*William Carrick*" found that the best fishing grounds for coastal fishery were apparently in 20 to 25 fathoms of water. Our local fishermen seem to touch just the edge of the good fishing

grounds. If they were in a position to go farther out and to land their catch quicker, if they could continually fish from their boats and make use of all four of the daily tides, the result would be many times that of to-day's fishing. They could achieve all this if each village had a few boats fitted with motors—not so much for fishing as for the transport of fishes. The anchoring of boats and buoys by means of an ordinary light anchor will be possible for our fishermen if they have motor-driven winches at their disposal for lifting these anchors out of the soft mud.

Crude Oil motors can be fitted to the existing fishermen's boats. The men themselves when they heard of this, were much interested and suggested that they would stay in sea and continue fishing with all tides if a motor-boat would bring them food and water and take the catches home to market regularly.

So much can be done here and it is very satisfying to hear that the Development Department of Messrs. the Burmah Shell Oil Storage and Distribution Co. Ltd. are contemplating the fitting of a fishing boat with a suitable and economic motor to demonstrate its usefulness along the coast. A start made in this direction will probably be the nucleus of a development of our fishing industry to a state which will compare or even excel that of other countries with sea fisheries. The conditions on our coast are, I believe, better than those of other countries: fishes are abundant, the waters with the exception of the four monsoon months are not tricky and free from dangers, the weather constantly fine and the Indian fishermen as hard working and daring as any other fishermen.

If so, by comparatively small efforts, the supply of fishes to the coastal markets can be multiplied. There remains another important task to be taken in hand at once: The markets of bigger towns prefer and require special types of fishes and, at the same time, fully grown fishes; a fish-preserving industry can only use the best fish material; thirdly the catching of immature fishes must be prevented in order to protect regular supplies. Sea-fishing in other countries could only be developed fully after a thorough knowledge of the good fishing grounds and the migration of fishes had been obtained, and this applies the more to fisheries in Western India, as we have—besides the observations of the "*William Carrick*"—no knowledge about the occurrence of fishes beyond the 10-fathom water mark. Unless we know *where* and *when* and in *what depth* the various types of our valuable market fishes are to be found, a fishing industry cannot grow. Only when the scientist can tell the fishermen that at such and such time of the year and at such place and in such depth he will find the big pomfrets or Goal or Karel, etc., can we hope for an increase of the Indian wealth through sea-fishing in our province. The financial results of the work of the "*William Carrick*" were far behind expectations. This is due to the fact that every unorganized fish-market will refuse to take up chance deliveries at decent prices but I am confident that our fish trade will be only too keen to make use of any regular and reliable supplies of fishes which are in demand. Therefore the scientist must begin to work to help the fishermen. A Fishery Institute with its own steamers and with a staff of experts to gain

and collect the necessary scientific knowledge would be the preliminary requirement. However, in times of political unrest and a vast economic depression, it is too much to hope that Government will be able to provide sufficient funds for such an Institution.

There is however a way to collect valuable information from the fishermen themselves if everyone interested in the problem and living in a fishing port, along our coast, will help to collect, say every month, information as to where and in what depth and what quantities the fishes are caught, which species are then prevalent in his market and at the same time measure the sizes of the fishes caught. The fishermen are very willing to give such information with a fair accuracy.

The Curator of the Bombay Natural History Society—to whom I owe this suggestion, is willing to give any assistance that may be necessary. I venture therefore to appeal to any layman who is willing to help in this important scheme, to communicate with the Curator and to provide him with regular information of the kind just mentioned. Even occasional information is of value and nobody should be reluctant to forward any observation however important or unimportant he may consider it.

But we have still another difficulty to overcome: the vernacular names of our sea fishes change with almost every district and the information gained from fishermen can naturally only be based on the local vernacular names given by the fishermen.

Here again the Bombay Natural History Society is willing to help. We will have to find out the scientific name to every vernacular name given to market fishes along our coast. For this purpose one specimen of each fish should be taken from the fishermen and the vernacular name written with an ordinary pencil on a strong label which is best tied to the fish's tail. The fish should immediately be put into a solution of 2 per cent Formalin (Formaldehyde).¹ A number of fishes should then be sent in a soldered kerosene tin or an earthenware vessel, etc., to the Society who will classify the fish and inform the sender about its scientific name. This valuable information will provide a basis for a study of the migrations and habits of our edible fishes.

I began to collect the vernacular names of the market fishes in Chimbai-Bandra in October 1930 and am publishing below the first list of vernacular names, which I hope, will be followed by many others also from other places. Unfortunately, I had to leave for Europe just after starting the collection and classification of the Chimbai fishes. Therefore my list is anything but complete—while my note is a sketchy one in all parts. My reason for publishing it is my belief that it is necessary to make some start in this direction and because I trust that this note will induce other members of the Bombay Natural History Society to co-operate in the same direction.

¹ Formalin can easily be obtained from any druggist and is not expensive. The 40 per cent solution sold in the trade should be mixed with fresh water in a proportion of 1 part Form. to 10 parts fresh water.

*List of Fish caught during the Month of October 1930 in
Chimbai-Bandra.*

Scientific Names.

Sciaena sina (Cuv. et Val.).
Otolithus argentius (Cuv. et Val.).
Sciaenoides pama (Ham. Buch.).
Polynemus sextarius (Bl. et Schndr.).
Engraulis hamiltonii Gray.
Pellona filigera Cuv. et Val.
Clupea? atricauda (Bleek.).
Caranx djedaba (Forsk.).
Coilia dussumieri (Cuv. et Val.).
Therapon jarbua (Forsk.).
Sillago sihama (Forsk.).
Trichiurus savala Cuv.
Caranx auricoronæ Chaudhri.
Harpodon nehereus (Les.).
Tetrodon lunaris (Bl. et Schndr.).
Sciaena vogleri (Bleek.).
Sciaena semiluctuosa (Cuv. et Val.).
Stromateus cinereus (Bloch.).
Stromateus cinereus (Bloch.).
Mugil kelaartii Gunth.
Caranx gallus (Linn.).
Trichiurus haumela (Forsk.).

Pteroplatea micrura (Schndr.).
Dasybatus zugei (Mull. et Hen.).
Cybium commersonii (Lacep.).
Ephippus orbis (Bloch.).
Hilsa toli (Bloch.).
Carcharias laticaudus (Mull. et Hen.).
Sciaenoides brunneus Day.
Chirocentrus dorab (Forsk.).
Arius macronotacanthus (Bleek.).
Lacatirus lactarius (Bl. et Schndr.).
Cynoglossus macrolepidotus (Bleek.).
Polynemus plebeius (Lacep.).
Clupea sp.
Hemirhamphus xanthopterus Cuv. et Val.
Hilsa ilisha (Ham. Buach.).

Mahrathi Names.

Goal Doma or Goal.
Tela Doma.
Kala Doma.
Maya.
Baderkanti.
Dolkanti.
Kanat. (Sardine).
Denkha bagras.
Manla.
Nakhera.
Murdi.
Tunkri waghti.
Patri.
Bombil. (Bombay Duck).
Khaen.
Tela Doma.
Bombera.
Serga or Pamhphlit.
Kaula.
Selpa.
Tzaan.
Pitiorkti or Piti waghti.
Bala or Balwaghti.
Pakert (s).
Sola.
Tonri.
Pimpru.
Bing or Bingla.
Mushi.
Kontvil or Kontla.
Dantal.
Singala or Shingala.
Lepti.
Lepti. (Flat fish).
Darvil.
Gonas.
Toli.
Palkhati.

THE BUTTERFLIES OF THE SIMLA HILLS.

BY

G. W. V. DE RHE-PHILIPPE, F.E.S.

Part II

(Continued from page 183 of this Volume).

SATYRIDÆ.

Quite a number of species of this family are to be found within the district, and a few of them are butterflies which are amongst the most common of all seen in these hills. Many of the species are, on the other hand, comparatively rare in so far as individual numbers are concerned; and these, keeping as they do to difficult nullahs and thickly overgrown country, have to be looked for and worked for. Sombre coloured insects for the most part, they do not attract attention; and even when seen, are troublesome to catch amongst the bushes and jungle they affect. It is seldom, therefore, they are well represented in the ordinary collector's 'bag'; and information, other than what one gathers oneself or from the few more serious students of entomology, is hard to come by. I was never able to obtain as much as I could have wished to do, and my notes of some of the species are therefore somewhat scrappy. Still the family is interesting enough and merits more attention than it gets.

*50. *Mycalesis francisca sanatana*. Moore.

(Bing. 51; deN. 89; Ev. D2 (5)).

Recorded 'Kulu to Burma', but extremely rare in these western hills, though more common eastwards. I have not taken it anywhere nearer than Mussoorie, nor seen any actually taken in the district. It flies both summer and autumn elsewhere.

51. *Mycalesis perseus typhlus*. Fruhstorfer.

Mycalesis perseus blasius. Fabricius.

(Bing. 53; deN. 96, 99; Ev. D2 (9)).

These have hitherto been considered as the dry and wet season forms of the same species, but Evans has now treated them as slightly differentiated races, *typhlus* being relegated to the continental plains, and *blasius* to the Himalayas and Burma. Both appear within our limits—fairly commonly in the lower hills and valleys, much more rarely at altitudes above 3,000 ft. Can be taken throughout the year except in the very cold months.

52. *Mycalesis mineus mineus*. Linnaeus.

(Bing. 54; deN. 97; Ev. D2 (10)).

Fairly common in suitable country at the lower altitudes, April to November.

53. *Mycalesis visala visala*. Moore.

(Bing. 57; deN. 99; Ev. D2 (12)).

Evans has restricted the westerly range of this species to Kumaon, but I found it fairly common in the Mussoorie Dun and I once took a battered specimen in the jungle country below Kalka. Will only be found at the foot of the hills.

54. *Mycalesis lepcha lepcha*. Moore.

(Bing. 64 ; deN. 111 ; Ev. D2 (30)).

Rather scarce in the district which is at the westerly limit of its range, but common further east from Garhwal to Kumaon. Most likely to be found in the spring and early summer at elevations up to 5,000 ft. in the jungle terrain affected by all *Mycalesis*, but appears sporadically at other seasons and in the inner hills.

55. *Lethe sidonis vaivarta*. Doherty.

(Bing. 88 ; deN. 149 ; Ev. D3 (7)).

I found this species very common in Dalhousie one October and it is plentiful in the autumn months in the Mussoorie and Kumaon Hills, but, though I have taken occasional specimens in Simla, it never, for some reason, seems to be common in this district. Is almost wholly an autumn butterfly and is not, as far as I know, found below 6,000 or 7,000 ft. Prefers deep forest.

56. *Lethe maitrya*. deNiceville.

(Bing. 92 ; deN. 150 ; Ev. D3 (8)).

Essentially a species of the higher and inner ranges. The late Col. Chaldecott found it fairly plentiful near the Jalauri Pass in September, and I have a specimen from the Narkanda forests taken in October. Would seem to be a post-monsoon insect.

*57. *Lethe nicetas*. Hewitson.

(Bing. 91 ; deN. 151 ; Ev. D3 (13)).

Recorded from the Himalayas from Kulu eastwards, but is rare everywhere towards the western limits of its range. It will be confined to the inner hills. I have not seen it in the Simla area.

58. *Lethe jalaurlida jalaurlida*. deNiceville.

(Bing. 111 ; deN. 158 ; Ev. D3 (17)).

This species was discovered by deNiceville near the Jalauri Pass into Kulu, and it is not rare there just before and during the monsoon months. It keeps to the inner ranges and will probably be found in forest country on Huttoo, the Chor and other lofty mountains.

*59. *Lethe goalpara narkanda*. Fruhstorfer.

(Bing. 116 ; deN. 156 ; Ev. D3 (20)).

I have not seen this. It is said to be very local, and, like others of this group, is confined to the higher hills. Some lucky collector should find one of its haunts in the forests beyond Narkanda.

60. *Lethe rohria dyrta*. Felder

(Bing. 79 ; deN. 139 ; Ev. D3 (24)).

The most common species of the genus in the district. May be picked up in almost any well-wooded locality between 6,000 ft. and 9,000 ft. between May and October.

61. *Lethe confusa confusa*. Aurivillius.

(Bing. 82 ; Ev. D3 (27)).

Fairly common here and becomes more so as one goes east. Like other *Lethe*s, prefers wooded country. Flies from spring to autumn, but is scarcer after the rains.

62. *Lethe verma verma*. Kollar.

(Bing. 85 ; deN. 146 ; Ev. D3 (28)).

Nearly as abundant as *rohria dyrta* and in similar localities between June and September.

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63. *Lethe insana insana*. Kollar.

(Bing. 81 ; deN. 142 ; Ev. D3 (31)).

Not very common, but may, occasionally, be found in forest country from 6,000 to 8,000 ft. from June to October. All my Simla specimens were caught on the northern face of the Mashobra-Mahasu ridge.

*64. *Lethe pulaha pulaha*. Moore.

(Bing. 120 ; deN. 142 ; Ev. D3 (47)).

Ranges from Chamba to Sikkim, but is apparently very rare everywhere west of Kumaon, for I have never come across it or seen it in any of the collections from the Western Himalayas. Is probably confined to the inner hills.

*65. *Lethe yama yama*. Moore.

(Bing. 122 ; deN. 162 ; Ev. D3 (52)).

I found this species fairly common in June in Naini Tal, but have not come across it further west. It is recorded from Kulu and will undoubtedly be found in the intervening country. From my experience of its habits in other places, I would expect it to be on the wing for a few weeks only before the rains.

*66. *Orinoma damaris*. Gray.

(Bing. 125 ; deN. 168 ; Ev. D5).

Recorded from Kangra to Upper Burma, but is local and rare everywhere. I have never taken it anywhere.

67. *Pararge (= Satyrus) schakra*. Kollar.

(Bing. 129 ; deN. 172 ; Ev. D4 (2)).

This little chap, who rather reminds one of the ' Wall Brown ' in England, is one of the most common of the Simla butterflies. It flutters about the road sides and over every patch of stony ground almost throughout the year.

Pararge mœrula. Felder.

(Bing. 130 ; deN. 173 ; Ev. D4 (3)).

This butterfly really belongs to the extreme north-west, though it has been reported as extending to Kumaon. I have some doubts whether it will be taken in the Simla area ; but I include it as there is a chance that it may wander into the interior boundaries. It is rare everywhere.

68. *Pararge (= Rhaphicera) moorei*. Butler.

(Bing. 127 ; deN. 170 ; Ev. D4 (6)).

Not uncommon, but somewhat irregular in appearance and very local in its haunts. I could not discover it in the Simla District for years : and then, one summer between May and September, I got several in two particular glades of the forests in Mashobra and Mahasu. It was also taken in fair numbers by a collector on the road to Kulu below the Jalauri Pass.

*69. *Maniola pulchra*. Felder.

(Bing. 143 ; deN. 198 ; Ev. D (7)).

Not rare in Kashmir and Pangi, and is found in Kulu and eastwards along the inner ranges as far as Kumaon. I have not seen it from the Simla area, but it should occur in the summer months in the high country of the interior.

*70. *Maniola lupinus cheena*. Moore.

(Bing. 143 ; deN. 194 ; Ev. D7 (5)).

*71. *Maniola davendra davendra*. Moore.

(Bing. 139 ; deN. 191 : Ev. D7 (8)).

The remarks on the previous species apply equally to these two. I have not seen either from within the district myself, but I was told by a P. W. D. road Engineer that a *Maniola*, probably *cheena*, is to be seen on the Himalaya-Tibet road towards Chini.

72. *Nytha parisatis paris*. LeCerf.

(Bing. 138 ; deN. 176 ; Ev. D8 (1)).

This species is not uncommon, but it needs to be looked for in suitable places and at the right season. Though an occasional specimen may be picked up in the autumn, the real time is the few weeks just before the monsoon begins. It keeps to rocky nullahs and slopes and, while it seldom flies fast or far, it settles quickly and unobtrusively, so that its course has to be closely watched.

Nytha mniszecchi baldiva. Moore.

(Bing. 134 ; deN. 180 ; Ev. D8 (4)).

An inhabitant of the inner and higher ranges which may possibly be found along the upper reaches of the Sutlej towards Chini.

73. *Aulocera brahminus brahminus*. Blanchard.

(Bing. 148 ; deN. 189 ; Ev. D11 (1)).

Has been taken in Kulu and I have one from the Sutlej valley above Rampore caught in August. It should occur nearer Simla ; but it is rare or may possibly be overlooked in the crowds of other species of the genus.

74. *Aulocera padma padma*. Kollar.

(Bing. 150 ; deN. 187 ; Ev. D11 (2)).

75. *Aulocera swaha swaha*. Kollar.

(Bing. 149 ; deN. 188 ; Ev. D11 (3)).

These two species are such a common feature of the Simla fauna and are superficially so alike that a casual observer would easily look on them as the same, that they might well be dealt with together. Who has not noticed the heavy looking butterflies, black with a white band across the wings, which fly about and settle on the slopes by the road sides and on the very road itself, and then lean over till the wings almost rest on the soil ? Of the two, *padma* is distinctly the larger and darker and, in Simla, seems to appear a trifle later in the season. It is, except locally, not quite so abundant as *swaha*. The latter generally comes into prominence in May, and after that is seen everywhere from 5,000 to 10,000 ft. Both are on the wing till late autumn, but those seen after September are usually worn and faded.

76. *Aulocera saraswati*. Kollar.

(Bing. 151 ; deN. 190 ; Ev. D11 (4)).

Has the genus general pattern and colouring, and is rather liable to be overlooked in the crowds of *swaha* ; but the beautiful brown striations on the undersides of the wings are distinctive. May occasionally be found anywhere from July to September, but has a tendency to concentrate in certain localities and in these is almost as common as the two preceding. One of these favoured spots was between the 4th and 5th milestones on the road to Mahasu, where the flowers of a thistle and of some other compositæ attracted scores. Another gathering ground was a length of the lower road on Elysium Hill.

77. *Erebia shallada*. Lang.

(Bing. 178 ; deN. 233 ; Ev. D13 (3)).

78. *Erebia nirmala nirmala*. Moore.

(Bing. 180 ; deN. 239 ; Ev. D 13 (4)).

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79. *Erebia scanda*. Kollar.

(Bing. 182; deN. 235; Ev. D 13 (5)).

80. *Erebia hybrida*. Butler.

(Bing. 181; deN. 238; Ev. D 13 (6)).

81. *Erebia annada caeca*. Watkins.

(Bing. 181; deN. 237; Ev. D 13 (7)).

*82. *Erebia hyagriva*. Moore.(Bing. 179; deN. (as *Ypthima*) 179; Ev. D 13 (8)).

The habits, localities and seasons of these six *Erebias*, lumped by the Simla schoolboy under one comprehensive and very appropriate name of 'hoppers', are so much alike that they can conveniently be grouped for notice. All are insects which favour wooded, shady localities where it is comparatively damp; all appear in the summer months and continue to fly till the autumn but, speaking generally, are most abundant during and for a short period after the rains; all have the same general habits of flight and settling. Not only are their ways and seasons alike, but they are very similar in appearance on the wing and it is only experience which can then differentiate between them and often a close examination and comparison with detailed descriptions has to be made before individuals can be satisfactorily placed.

Of the species found in and near Simla, *nirmala* is the only one that can be called really common. It is the smallest and darkest of the group and appears in great abundance in June and July, fluttering about the shady roads and hillsides. *Scanda* and *annada* are probably the next in numbers and are larger, lighter coloured (mainly because of the white irrorations on the undersides) insects and are rather more frequently taken towards the end of or just after the rains. *Hybrida* and *shallada* are somewhat uncommon, while *hyagriva* is distinctly rare.

To get a good series of all the species, it is advisable to capture every *Erebia* that is not clearly a *nirmala* and examine it before release; and any you are not then certain about should be retained for closer examination and comparison at home with recorded descriptions.

83. *Ypthima nareda nareda*. Kollar.

(Bing. 163; deN. 209; Ev. D 14 (4)).

The *Ypthimas*, or 'Ringlets', are small, inconspicuous butterflies which usually lurk in undergrowth and bushes and are not often seen abroad; but if point is made of looking for them, *nareda* will be found to be not uncommon. It does not seem to go below 5,000 ft. or above 8,000 ft. and may be picked up any time between May and October.

84. *Ypthima asterope mahratta*. Moore.

(Bing. 173; deN. 213; Ev. D 14 (6)).

More a plains species than one of the hills. Is not uncommon in the country round Kalka and probably extends up the valleys.

85. *Ypthima hubneri kasmira*. Moore.

(Bing. 170; deN. 217; Ev. D 14 (10)).

Also a butterfly of the plains and lower hills and to be found, though not very commonly, around Kalka. I have as yet nowhere found it above 3,000 ft. and I do not think it goes any distance into the hills.

*86. *Ypthima avanta avanta*. Moore.

(Bing. 167; deN. 207; Ev. D 14 (12)).

Said to be found throughout the Himalayas and to be common in Kulu. I have not seen it anywhere west of Kumaon, where it is, at low elevations, a spring butterfly.

87. *Ypthima baldus baldus*. Fabricius.

(Bing. 154 ; deN. 204 ; Ev. D14 (14)).

Very common in the Central and Eastern Himalayas up to about 4,000 ft., but is apparently much scarcer towards the western limits of its range. Should be looked for in the lower hills and valleys from May to October.

*88. *Ypthima indecora*. Moore.

(Bing. 153 ; deN. 206 ; Ev. D14 (15)).

Recorded from Kashmir to Kumaon, but I have not taken it within the district or anywhere near. It is common enough elsewhere.

89. *Ypthima sakra nikæa*. Moore.

(Bing. 161 ; deN. 226 ; Ev. D14 (20)).

This is, by far, the most common of the genus in the Western Himalayas. It occurs everywhere in suitable country from 4,000 up to 9,000 ft. from May to October.

Orsolriæna medus medus. Fabricius.

(Bing. 72 ; deN. 92 ; Ev. D16).

A species of the plains. It has been recorded from Ambala, just outside the district, and it is quite probable that an occasional specimen may find its way into the country round Kalka.

90. *Melanitis leda ismene*. Cramer.

(Bing. 191 ; deN. 243, 244, 249 ; Ev. D22 (1)).

A common butterfly of the plains. I have noticed it at Kalka and have seen specimens in a soldier's collection made round Sabathu ; but it does not, as far as I am aware, extend far into the hills. May be 'flushed' in scrub jungle at any time but flies freely, especially round the trunks of trees, in the evening. This habit and the dead leaf appearance of the undersides of the wings have led to its being called the 'Evening Leaf'.

Elymnias hypermnestra undularis. Drury.

(Bing. 202 ; deN. 256 ; Ev. D25 (1)).

Has not yet actually been found so far to the west, but it is not uncommon in the Mussoorie Dun and it is possible that one or two may turn up in the damp river valleys at the foot of the hills.

(NYMPHALIDÆ)

We come now to a family of butterflies which, in India, has probably received more attention from the general collector than any other. It is easy to see why this should be the case. Some of the species of which it is comprised are an outstanding feature of the insect fauna of every place ; and being showy and as a general rule, common, they usually attract attention. They present such a diversity of form and size, of pattern and colouring that they arouse interest ; and, with the interest, the idea of 'making a collection' is often born. The Simla Hills are fairly well provided with members of the family ; and though there are, of course, several which are distinct rarities, a goodly proportion of the species are numerous in individuals, and soon become the backbone of every collection that is put together.

The habits of the *Nymphalidæ* are almost as varied as their colouring ; but, though a few of the species display a preference for damp and shady surroundings, they may, as a group, be said to be sunloving insects who delight to flaunt their charms among the flowers of the gardens and meadows and around their favourite shrubs and trees. Open sunny nullahs with forest growth around and clearings and gaps in the woods attract many ; while some species have a marked predilection for the plateaus and downs on the very tops of hills.

And now to continue our list.

91. *Charaxes fabius fabius*. Fabricius.

(Bing. 244 ; deN. 570 ; Ev. F1 (7)).

Has been recorded from Chamba and Mandi and appears generally along the foot of the hills and the Gangetic Plain, getting more common towards its easterly range. Will occur, though rather rarely, in the Kalka area and up the valleys, but not likely to go above 5,000 ft. Flies spring and autumn.

92. *Eribœa athamas athamas*. Drury.

(Bing. 245 ; deN. 568 ; Ev. F2 (2)).

A very strong flying insect like all the others of the group and appropriately named the 'four tail' by school boys. Not rare and may be taken fairly frequently from spring to autumn. The most likely haunts are rocky nullah beds where it flashes from tree to rock, frequently settling on patches of damp sand. Sometimes flits round some favoured tree ; while exuding sap and ordure of any sort is always a strong attraction.

93. *Eribœa dolon dolon*. Westwood.

(Bing 251 ; deN. 565 ; Ev. F2 (7)).

A distinctly rare member of the genus and especially so in the Western Himalayas. Anyone getting a specimen can deem himself fortunate. Very strong and rapid on the wing and difficult to catch unless absorbed in sap drinking. I have not actually taken it in the Simla District, but I picked up a wing one June on a path on the Retreat hill. A summer butterfly in the Kumaon Hills and presumably the same here.

94. *Dilipa morgiana*. Westwood.

(Bing. 262 ; deN. 328 ; Ev. F5).

A beautiful insect and always a prize because of its rarity throughout its range. I could not find it in Simla for years ; and then, one June, I had the fortune to hit on a small colony of males flying round a brown oak tree on the top of Kufri Hill. I picked up another male later near a water trough on the road to Mashobra. deNiceville took some males on the top of Tara Devi. Isolated trees on hill tops are, in my experience, the most likely places for males. Females are very rare indeed and seem to skulk in the valleys. I know of only one taken within our area. This was on the road to Sipi village, also in June. It also flies in the autumn.

95. *Apatura ambica ambica*. Kollar.(Bing. 255 ; deN. (as *Namouna*) 329 ; Ev. F7 (5)).

The Indian 'Purple Emperor' is not at all uncommon in the Central and Eastern Himalayas, but is rarer in the North West. Flies round trees, but is much more likely to be caught in rocky nullahs with running water. Females are very much rarer. Found summer and autumn but the former is the better season.

96. *Sephisa dichroa*. Kollar.

(Bing. 270 ; deN. 327 ; Ev. F9 (1)).

The 'Silkie' of the Simla school boy is a feature of open oak woods in May and June. One may often see a dozen or more flitting round a tree or coming down to drink at damp patches by the road side. There is a less prolific autumn brood.

97. *Parhestina persimilis zella*. Butler.

(Bing. 266 ; deN. 337 ; Ev. F11 (1)).

Never common, but a regular worker will usually pick up a few each season. Nullahs and open woods in the summer will be the most promising localities.

*98. *Parhestina nicevillei*. Moore.(Bing. 267; deN. (as *Zella*) 338; Ev. F 11 (2)).

This rare species really belongs to a zone further west round Dalhousie and Chamba. It is said to extend to the Mussoorie hills. I have never seen a specimen from our district.

*99. *Calinaga buddha buddha*. Moore.

(Bing. 451; deN. 435; Ev. F 14).

Very rare and I have never had the luck to get one. Most of those recorded were from Kulu. Like the Papilio, *Chilasa agestor govindra* which it very superficially resembles, it is a butterfly of the very early spring months, though odd specimens sometimes carry on till June and July.

*100. *Dichorragia nesimachus*. Boisduval.

(Bing. 274; deN. 434; Ev. F16).

Though the recorded range of this species is 'from Kulu to Burma', I have some doubts of its right to be included among the Simla District fauna. It is really an Eastern Himalayan butterfly, which, as Hannington reports in his paper on the 'Butterflies of Kumaon', is very rare even on the eastern borders of that district. If found in the Simla Hills, it will be in the low river valleys.

* 101. *Stibochiana nicea nicea*. Gray.

(Bing. 275; deN. 418; Ev. F 17).

Also more a butterfly of the Indo-Malayan fauna, but it is common as far west as Kumaon at any rate. There are specific records from the Kulu Valley and from the Sutlej near Kotgarh: but it is rare so far to the west. Will occur in the river valleys up to about 4,000 ft.

102. *Euthalla garuda anagama*. Fruhstorfer.

(Bing. 302; deN. 513; Ev. F 18 (14)).

The North Western race of the species is not uncommon though it does not often figure in collections from these parts. I have seen it near Kalka. The larva feeds on the mango tree, and the imago will almost certainly be found wherever the mango grows. It flies almost throughout the year.

103. *Euthalla lubentina indica*. Fruhstorfer.

(Bing. 296; deN. 517; Ev. F 18(17)).

Somewhat rare within our limits but will be picked up occasionally anywhere up to 8,000 ft. in the summer or autumn. I have taken it at Kufri; but the low warm valleys would be more profitable hunting grounds.

104. *Dophla patala patala*. Kollar.

(Bing. 286; deN. 490; Ev. F18 (25)).

Not often seen at large, but is not uncommon in the localities it favours. It affects oak woods and may sometimes be seen round these trees on Jakko; but nullahs with oak growth around are its special haunts. It was very common in some ravines behind the Mahasu ridge one year. Appears just before the rains and flies till August or September. Excluding sap or rotting fruit will always attract it if it is in the neighbourhood.

105. *Llinitis danava*. Moore.

(Bing. 318; deN. 446; Ev. F24 (2)).

Rare throughout its range, and specially so here at its western boundary. I remember that, very many years ago, the catching of a 'Rainbow Tapsel,' as the female was called, was a notable event among the Simla schoolboys. I have taken a female in the stream below Annandale; and I once came across quite a small colony of males in a secluded corner of the Glen. This corner was also, it so happened, a rendezvous of the common rock-snake, and

there were several of these reptiles slithering about the damp rocks. They are harmless, of course ; but—well, I confess that if there is anything I have always loathed, it is a snake of any kind ! I caught one or two of the *danavas* which were well away from the cluster of snakes and then decided to do my shikaring elsewhere. I have only come across the butterfly, both here and in the Kumaon and Mussoorie Hills, in October, so it is presumably a post monsoon species.

Limnitis procris procris. Cramer.

(Bing. 310 ; deN. 452 ; Ev. F 24 (7)).

Not as yet recorded from within our limits, but it is not uncommon in the West Central Himalayas and in the Mussoorie Dun. I have seen it in the Jumna Valley between Mussoorie and Chakrata, and as this is less than fifty miles from our area, there is every possibility of its turning up in the low valleys round Kalka.

106. *Limnitis trivena trivena.* Moore.

(Bing. 315 ; deN. 451 ; Ev. F24 (8)).

A very worn female taken one September near Kufri was, for several years, the only specimen I found. But the species is common enough if only one hits on the right places and season. It is on the wing for only a very short period in May and early June, and then keeps to certain localities. I discovered this when I first made a timely expedition to the nullahs behind the Mahasu-Mashobra ridge, in some of which it could be taken, literally, by hundreds. I have since also found it occasionally in the Water-works area on the nearer side of this ridge and, once, in the Summer Hill nullah. To get really good specimens one must take them within almost a single particular week, as they soon get worn and scrubby. The one I had previously taken in September was probably an unusually hardy survivor of the June brood.

Pantoporia selenephora selenephora. Kollar.

(Bing. 326 ; deN. 467 ; Ev. F25 (4)).

The Simla District is on the borders of the known westerly range of this species, and it has hitherto not been definitely reported from nearer than Mussoorie. I know, however, of one which was caught in the vicinity of Paternala on the Chor ridge, and it may yet be found within our limits.

107. *Pantoporia opalina opalina.* Kollar.

(Bing. 328 ; deN. 462 ; Ev. F25 (8)).

Exceedingly common from spring to autumn. May be seen pretty nearly everywhere sailing about the trees. Does not appear to descend below 4,000 ft.

* 108. *Pantoporia asura asura.* Moore.

(Bing. 333 ; deN. 455 ; Ev. F25 (13)).

Has been recorded from Kulu and from Kotgarh and ranges eastwards as far as Tenasserim. A rare butterfly everywhere and particularly so in the west. I have seen none taken within the Simla Hills.

109. *Pantoporia perius.* Linnæus.

(Bing. 331 ; deN. 454 ; Ev. F25 (14)).

A common Indian butterfly, but here again, Simla is the westerly limit of its range and it is by no means plentiful in the district. Col. Evans took one at San Damiano in June ; and I got one at the same season in scrub oak forest on the spur beyond Elysium Hill.

110. *Neptis mahendra.* Moore.

(Bing. 341 ; deN. 399 ; Ev. F20 (5)).

Not so ubiquitous as the next, but quite common spring to autumn.

111. *Neptis hylas astola*. Moore.
(Bing. 336; deN. 386; Ev. F26 (6)).

Neptis hylas varmona. Moore.
(Bing. 336; deN. 279, 385; Ev. F26 (6)).

The common 'sailer' which is to be seen everywhere right through the spring, summer and autumn. The *varmona* form is that found in the plains and low country, while *astola* is confined to the higher hills. Typical specimens of each of the two are easily distinguished, but individuals of an intermediate type may be found in the demarcating zone.

112. *Neptis yerburyii yerburyii*. Butler.
(Bing. 342; deN. (as *Nandina*) 397; Ev. F26 (9)).

Very similar in general appearance to *mahendra*, and likely to be mistaken for it especially as both species fly at the same time. *Yerburyii* is much the less common of the two, so it is just as well to take a good look at all the apparent *mahendras* before setting them free as 'not wanted.'

113. *Neptis sankara sankara*. Kollar.
(Bing. 344; deN. 466; Ev. F26 (10)).

Would be considered rare—till you discover its own particular domain. When such a spot is found, you can usually get all you need. The San Damiano nullah behind the Retreat Hill was generally a good place, but I have also taken it in the Catchment area and in the Summer Hill ravine. Is plentiful only in May and June and it disappears almost completely once the monsoon breaks.

114. *Neptis narayana narayana*. Moore.
(Bing. 346; deN. 367; Ev. F26 (23)).

Appears at much the same seasons and in the same places as the last, but is always very much rarer. It is necessary, in order to get really good series of these two species, to find one of their special haunts at just the right fortnight or three weeks of the season.

115. *Neptis ananta ananta*. Moore.
(Bing. 354; deN. 363; Ev. F26 (15)).

This is the only tawny yellow 'sailer' found in the North-West Himalayas and is distinctly rare at this end of its range. I have not taken it myself in the Simla Hills, but I have seen one caught on the Chail ridge. Wooded nullahs and damp clearings in forest are, judging by my experience elsewhere, the most likely spots for them.

- * 116. *Neptis zaida*. Doubleday.
(Bing. 348; deN. 365; Ev. F26 (25)).

A rare butterfly which I was never fortunate enough to get. I believe it prefers low elevations and flies only in the early summer.

117. *Cyrestis thyodamus ganescha*. Kollar.
(Bing. 364; deN. 544; Ev. F27 (4)).

The familiar 'Map butterfly' known, I expect, to every one who has taken any interest in Himalayan butterflies. Common from spring to autumn, and may frequently be seen floating gracefully around trees. They love the neighbourhood of watercourses and often settle on damp sand and rocks with outstretched wings.

118. *Pseudergolis wedah*. Kollar.
(Bing. 450; deN. 417; Ev. F29).

Might appropriately be called the 'Brown Map', for the black lines across the wings do suggest a map. Not uncommon but keeps to wet nullahs and damp shady glens. Flies spring to autumn.

119. *Hypolimnas misippus*. Linnæus.

(Bing. 398 ; deN. 420 ; Ev. F30 (1)).

Is essentially an insect of the plains and is not common so far to the north-west as the Punjab ; but it appears sparingly in Ambala and the country below Kalka. I have never seen it in the actual hills.

120. *Hypolimnas bolina*. Linnæus.

(Bing. 397 ; deN. 419 ; Ev. F30 (2)).

Also prefers the plains but extends well into the hills. I have seen it in Simla, but it is scarce anywhere above 5,000 ft. After the rains is the best time for them.

121. *Kallima inachus huegell*. Kollar.

(Bing. 403 ; deN. 552 ; Ev. F34 (2)).

The well-known 'Oak Leaf' seen in pretty nearly every collection in India and in every case of exotic butterflies in England. Is not rare anywhere and may frequently be seen in oak woods flashing from tree to tree and suddenly vanishing as it settles. Often quite common in wooded ravines where there is a stream. The undersides of the wings, while always resembling a dead leaf, vary so much in details of pattern, that it is interesting to set a series to show this aspect alone.

122. *Precis* (= *Junonia*) *hierta hierta*. Fabricius.

(Bing. 374 ; deN. 349 ; Ev. F35 (1)).

123. *Precis orithya swinhœl*. Butler.

(Bing. 372 ; deN. 350 ; Ev. F35 (2)).

Why the first of these should have been called by the Simla schoolboy a 'Gentleman's Fancy' and the other a 'Lady's Fancy' I was never able to fathom ! Both, in the hills, like open, sunny country, and grass lands in particular, though, in the plains, they flit about gardens and road sides equally freely. The 'Gentleman's Fancy' is rather the less common of the two ; but both will be seen frequently in summer and autumn anywhere up to 8,000 or 9,000 ft.

124. *Precis lemonias persicaria*. Fruhstorfer.

(Bing. 371 ; deN. 347 ; Ev. F35 (3)).

Very common in gardens and open hillsides from spring to autumn.

125. *Precis almana almana*. Linnæus.

(Bing. 375 ; deN. 344, 345 ; Ev. F35 (4)).

Exceedingly abundant in the plains and lower hills, but does not appear to venture freely into the higher ranges. I have seen one or two of the wet season 'asterie' form in valleys below Simla, but have no note of any appearance in Simla itself.

126. *Precis iphita*. Cramer.

(Bing. 370 ; deN. 343 ; Ev. F35 (6)).

The 'Chocolate' is common pretty nearly everywhere and seems to shun only densely wooded country. Flies from early spring to late autumn.

127. *Vanessa cardui*. Linnæus.

(Bing. 376 ; deN. 520 ; Ev. F36 (1)).

Our cosmopolitan friend the 'Painted Lady'. It is, of course, common everywhere in the district. Towards the plains it is, more or less, restricted to the autumn and winter months, but flies in the hills practically throughout the year. Open ground with thistles scrub is their special home.

128. *Vanessa indica indica*. Herbst.

(Bing. 377; deN. 521; Ev. F36 (2)).

The Indian 'Red Admiral' is common at all times. Like the last, it loves thistles.

129. *Vanessa canace himalaya*. Evans.

(Bing. 384; deN. 522; Ev. F36 (3)).

The 'Blue Admiral', though quite as abundant as his red confrère, does not wander abroad so freely. He prefers to keep near running water and will frequently be seen flitting up and down streams. I have also often noticed numbers in small oak plantations. Flies spring to autumn.

130. *Vanessa kashmirensis kashmirensis*. Kollar.

(Bing. 378; deN. 525; Ev. F36 (10)).

The Indian 'Small Tortoise shell' is such a common sight everywhere that it is quite unnecessary to say anything about it.

131. *Vanessa c-album cognata*. Moore.

(Bing. 385; deN. 591; Ev. F36 (6)).

Is not uncommon in Kashmir and in the Kulu hills, but is distinctly rare inside the Simla area, though it probably appears more frequently on the interior hills. My only record of its occurrence is one seen (alas, not caught) on a horrible patch of nettles on the Himalaya-Tibet Road near the Wildflower Hotel in Mahasu. This was in June, but the species also flies in the autumn.

132. *Vanessa xanthomelas fervescens*. Stich.

(Bing. 382; deN. 528; Ev. F 36 (11)).

The large Tortoise shell is not really as uncommon as one might imagine from the very few seen in ordinary collections. The reason for this is its very early and brief appearance. It begins to fly with the first advent of spring and has usually disappeared by the end of May. The valley between Snowdon and the Walker Hospital was a good place for them one year; and I have also taken one behind Jakko and another (a very *passee* relic of the brood) on Kufri Hill in June. It would probably be more abundant, and perhaps found later in the season, further in the hills.

133. *Symbrenthia hypselis brabira*. Moore.

(Bing. 390; deN. 539, 540; Ev. F38 (3)).

Somewhat rare in the Simla Hills, but getting less so towards the east. deNiceville took it in the bed of the Simla (Asni) River, and I got a very worn specimen one July in a nullah near Barogh. I have also seen one in a soldier's catch, taken below Dagshai. These records would indicate that it keeps to the lower elevations here, though I have taken it at 6,000 ft. in Mussoorie. Likes wooded ravines and flies summer and autumn.

134. *Symbrenthia hippoclus lucina*. Cramer.

(Bing. 386; deN. 532; Ev. F38 (1)).

Like the last, not common here though it is abundant from Mussoorie eastwards. It is, however, taken oftener than *brabira* in the valleys near the foot of the hills. Once, travelling up by train, I saw several butterflies which I am certain were this species in the nullah near Jabil station on the Kalka-Simla Railway.

*135. *Symbrenthia niphandia hysudra*. Moore.

(Bing. 390 as *brabira*; deN. 541; Ev. F38 (4)).

Recorded from Kashmir to Kumaon, but is rare everywhere. I have not come across it anywhere in its range.

136. *Argynnis hyperbius hyperbius*. Johanssen.

(Bing. 435 ; deN. 421 ; Ev. F39 (1)).

Not uncommon, though not as abundant, in Simla, as some of the other Fritillaries, or as it is at lower elevations and to the east. A collector is, however, bound to pick up some every year between June and October. Has a preference for open grass country, and, like so many other butterflies, is attracted by thistle flowers.

137. *Argynnis childreni sakontala*. Kollar.

(Bing. 433 ; deN. 423 ; Ev. F39 (2)).

The 'Dun Leopard', as this fine fritillary was called, is generally common from May to October, though it does not fly much during the very wet period of the monsoon. Sunny glades in woods and grass slopes are its favourite grounds and, like the preceding, it is attracted by thistle scrub. Does not go below 5,000 ft. or so.

138. *Argynnis kamala*. Moore.

(Bing. 431 ; deN. 425 ; Ev. F39 (3)).

Appears in May, is very common till July or August, and continues to fly till October. I always found it very plentiful on Mahasu and Kufri Hills, where it flits about gardens and every sunny slope. I have never seen it anywhere below 7,000 ft.

139. *Argynnis adippe jainadeva*. Moore.

(Bing. 430 ; deN. 426 ; Ev. F39 (6)).

Simla itself is rather too low for this species, and I doubt whether it will be found in the immediate vicinity. The late Colonel Chaldecott took several near the Jalauri Pass on the Kulu road, and it should occur round Narkunda and Baghi. Is mainly a summer butterfly, but will be seen, if less frequently, in October and November.

140. *Argynnis lathonia issæa*. Doubleday.

(Bing. 436 ; deN. 429 ; Ev. F39 (8)).

The 'Queen of Spain' fritillary is exceedingly common above 5,000 or 6,000 ft. at all times from spring to autumn, except during heavy monsoon weather. Avoids deep forest but is otherwise impartial as to its surroundings.

*141. *Argynnis pales sipora*. Moore.

(Bing. 441 ; deN. 432 ; Ev. F39 (13)).

I have not seen this butterfly in the Simla Hills though I know it has been caught in the interior. In Kashmir it keeps above 8,000 ft. and it will probably be found here only above the 10,000 ft. line in the Huttoo and Baghi neighbourhood.

142. *Melitæa arcesia sindura*. Moore

(Bing. 443 ; deN. 309 ; Ev. F40 (5)).

A friend who did a walking trip into the interior and incidentally collected a few butterflies brought back one of this species which he had caught in early June on the way from Kulu. I doubt whether it will be found within the district limits, but it should occur on the inner borders.

143. *Atella phalanta*. Drury.

(Bing. 416 ; deN. 314 ; Ev. F42 (1)).

Very common in the autumn everywhere up to about 8,000 ft. I have not noticed it particularly before the monsoon.

144. *Ergolis merlone tapestrina*. Moore.

(Bing. 449 ; deN. 299 ; Ev. F49 (2)).

This species, which is always so abundant in its own proper zone, is here nearing the north-western limits of its range. I have seen it at rare intervals near Kalka, but it does not penetrate far into the hills.

(ACRÆIDÆ)

This family is, in the main, an African one and is represented in India by two species only. Only one of these is known to extend into the North-west Himalayas, though it is just possible that stray members of the other may sometimes find their way into the plains bordering on the district.

145. *Pareba vesta anomala*. Kollar.

(Bing. 453 ; deN. 297 ; Ev. F51).

Not common in the Simla area, but an assiduous collector may generally count on getting two or three each season. I have taken it on Kufri Hill and one or two other places in the summer, and it will be found to show up at occasional intervals between 2,000 and 10,000 ft.

Telchinia violæ. Fabricius.

(Bing. 454 ; deN. 298 ; Ev. F52).

A continental species which is common in Oudh and which I know occurs as far to the north-west as Roorkee. There is a possibility that it may sometimes appear in the tract between Ambala and Kalka.

ERYCINIDÆ

A small group of the butterfly family, but the few species by which it is represented in the Simla Hills are, for the most part, common and rather interesting butterflies.

146. *Libythea lepita lepita*. Moore.

(Bing. 455 ; deN. 594 ; Ev. G1 (2)).

Evans' proposed name, the 'Beaks', or the old Simla schoolboy name of 'Snouters' are both very apt, as the elongated palpi distinctly suggest some such appellation. *Lepita* is very common about the hills from 5,000 ft. up to at any rate 9,000 ft. You may see them, from spring to summer, round damp roadside drains ; and every nullah has its inhabitants.

147. *Libythea myrrha sanguinalis*. Fruhstorfer.

(Bing. 456 ; deN. 592 ; Ev. G13).

Not nearly so common in the Simla Hills as the preceding, but the two species are so alike in habits and flight that it is probable that the rarer *myrrha* is often overlooked amongst the crowd of others. Look twice at every *Libythea* that you cannot definitely say is a *lepita* !

148. *Dodona durga*. Kollar.

(Bing. 460 ; deN. 597 ; Ev. G3 (1)).

I expect most folk in Simla have noticed this perky little fellow. He flies in his jerky, assured way about the roadside shrubs, and settles preening himself and apparently looking at you. Quite common from June till November and delights in sunny spots where there is plenty of shrub growth.

THE BUTTERFLIES OF THE SIMLA HILLS

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149. *Dodona dipæa nostia*. Fruhstorfer.

(Bing. 461 ; deN. 598 ; Ev. G3 (2)).

Not at all common in the Western Himalayas, though more frequently met with in the east. Habits and haunts much the same as the next, so it is liable to be overlooked.

150. *Dodona eugenes eugenes*. Bates.

(Bing. 463 ; deN. 604 ; Ev. G3 (3)).

Likes damper and shadier surroundings than *durga* and is best looked for in wooded nullahs and clearings in forests. Is fairly common in such places from May to October.

151. *Abisara echerius suffusa*. Moore.

(Bing. 474 ; deN. 614 ; Ev. G4 (5)).

A common butterfly of the submontane tracts of the Central and Eastern Himalayas, but much rarer between Mussoorie and Chamba. I have taken it near Kalka and it will sometimes be found in the ravines and damper clearings in this neighbourhood. Just before and during the rains is usually its favourite season.

(*To be continued.*)

THE CICADA: *LETHAMA LOCUSTA* WALKER.

BY

C. McCANN, F.L.S.

(With 5 text-figures).

It is a quiet October evening. Everything is at its best after the four months of rain. The sun is setting behind the Mahableshwar hills. Slowly the song of the various diurnal birds and insects dies out. The sun has gone leaving a faint glow in the sky. There is a lull and everything becomes silent for a little while. The diurnal creatures have gone to their rest and the nocturnal ones are performing their toilet and getting ready for their nightly routine. Night falls—there appears a jackal, he has a look all round to see if the coast is clear. All's well, away he goes slinking along under the cover of some bushes. A Horned Owl sails over my head. Flying-foxes whiz over. I am sitting on the edge of the Tableland at Panchgani. I am not interested in all these prowlers of the night. I am waiting for the nocturnal Cicada (*Lethama locusta*, Walker).^{*} Locally it is known as the "Croaker". They are very noisy creatures and rightly deserve the name. They have already started their chorus down in the valley where it is already darkening. I wait. The sound soon travels up to where I am sitting. It moves up in a regular wave till every bush around me is alive with "Croakers". They did not fly there. Where did they come from all of a sudden? Where do they spend their day? What is the meaning of all this noise? These are the questions I set myself, and I try to find the solutions in their behaviour. In the feeble light I closely watch the bushes about me. They are *Lantana* and *Lasiosiphon eriocephalus*, Decaisne. I take up my position near a bush of the former. I see three or four "Croakers" making their way up the stems. They have been spending the day at the bottom of the bush in rest.

They are noisy fellows, commencing to croak as soon as they begin to climb up to the branches, from their hiding places. They make for the topmost branches. This answers my first question and also the second. The light is just sufficient to discern them against the sky. The incessant croaking at once gives the position of the songster away. The noise is deafening not unlike the noise of pneumatic drills. I single out one and watch. He is too interested in his "vocal" production to take any notice of me. It is only the male who is capable of making himself heard for the females are voiceless. This calls to mind the words of the poet who commented on the bliss of married life 'among the Cicadas for they have voiceless wives!! They vie with one another in song—they enter into competition and quarrel with one another for positions of vantage. Their quarrels are far from fatal battles. They consist of a "kicking" and "shouldering" competition. One tries to "kick" the other off the branch on which two

^{*} My thanks are due to Mr. W. E. China of the Insect Department, British Museum, for kindly identifying the specimens for me.

or more are seated. When they have all left their resting places they frequently fly from one bush to another. "Croakers" from neighbouring bushes frequently come to quarrel with a songster who has already taken up his position. The stronger one succeeds in keeping the perch. The weaker flies off to a nearby branch. The croaking is incessant. The vanquished may be pursued, but there are several others to carry on the pandemonium on the same bush. When fighting the cicadas turn round and round the branch, one treading on the others' "toes", until such time as one gives in.

Whiz! something passes my head at high speed and alights close to my songster. It is another "croaker" but this is a silent one. Closer examination with the aid of a match (these cicadas are not as shy as the diurnal species, which fly off no soon they see anything moving) shows me that it is a female. She has a long ovipositor which immediately distinguishes her from the male. Besides, she is voiceless, having only rudiments of the song producing organs. There is a stir. My songster is aware of her presence and so are one or two of the others near by. Their song ceases and they move in her direction but slowly—too slowly. My "croaker" has already taken possession of her. Copulation now takes place. The others arrive but too late. Their song is now modified to an occasional croak. They crawl over and around the couple, but the latter are quite unconcerned. Disappointed, the rivals retreat to a little distance and commence their song with renewed energy in the hope that some other prospective mate might hear. In the meantime another female arrives and the process is repeated. The act is partially dorsiventral and is completed in

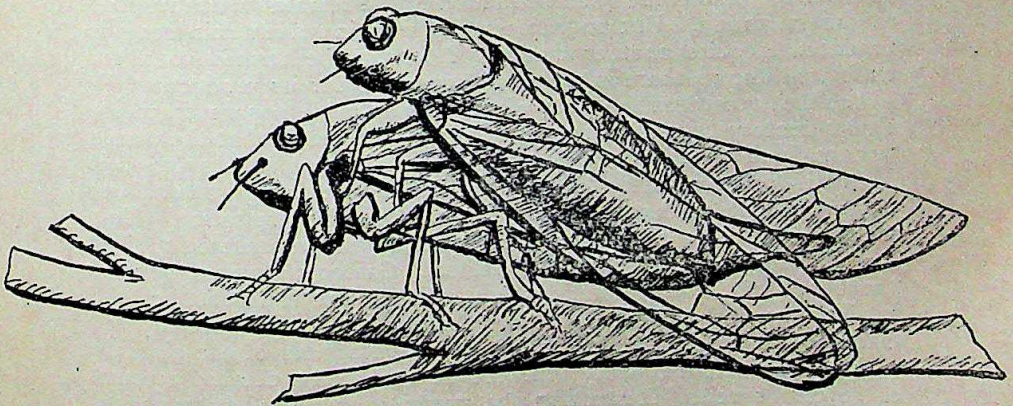


Fig. 1. Position of the Cicadas in copulation.

three to four minutes. All this time my box of matches helped me to watch the process. When the act has been consummated the female is released. The male is now silent and settles down to the more important business of feeding. The female goes off. This small observation answers the third question. The females of this cicada are attracted by the song of the males. Their song is a 'mating' song. It ceases completely after copulation.

I am satisfied with my answers and so I sit listening to the chorus around me. It gradually dies down. Then everything is quiet once more. The concert has ended. The performance only lasts for about an hour or a little more. The rest of the night is spent in feeding and in the meantime the females may be also laying their eggs.

Next morning I visit the same locality. Not a "croaker" is to be seen in the neighbourhood. Occasionally, a belated reveller, intoxicated with the juice of plants may be found lying about in the grass. He is silent but as soon as I pick him up, he utters short protestations by way of croaks indicating his disapproval of my interruption of his slumbers. However, had I not picked him up, he would probably have fallen a victim to the Kites (*Milvus govinda*) which were already on the prowl for insect food in the short grass—a daily proceeding of these birds in this particular locality.

During the time that these cicadas are wont to perform their "shrieking chorus", handling does not seem to retard the volume of sound produced in the least. A captive will continue his music in your hand.

THE MECHANISM OF THE SOUND-ORGANS.

The "vocal" efforts of cicadas are well known to most people. The intensity of the sound depends much on the size of the insect and on the type of "instrument" "he" is supplied with, for "she" is silent. Above I have given sufficient evidence to prove that the song of the cicadas is an expression of their sexual feelings and at the same time is really an attraction to the females which respond to the invitation. But to explain the way in which this song is produced is quite another matter. It cannot be termed vocal for as is well known there is a special apparatus for its production.

The first record of the song of cicada was made apparently in the eighth century before Christ, by Hesiod, who states that the cicada "pours forth from under his wings, his shrill song". As far as it goes his observation is correct. Aristotle and many other later observers believed that the sound was produced by respiration. This view was held for a considerable time and was perpetuated until it was disputed by Casserius and Galileo. Galileo's statement swept the board of the old traditions and was a clear conception of the modern spirit. Giulio Casserio (Casserius), a contemporary of Galileo, had already discovered the effective organs of the cicada's sound, even before Galileo. In 1600 he published a detailed account of several species, illustrating the tymbals and also the muscles. But we owe much to Réaumur (1740) whose accurate observations were confirmed by Carlet (1876) and other workers.

To be able to understand this most complicated and interesting sound-organ we must make a careful survey of all the parts concerned, both internally and externally. The rudiments of these organs are met with in the females but they do not function, hence all our remarks must necessarily be confined to the opposite sex in which the sound producing organs are developed to a remarkable degree, so much so that they have developed at the expense

of all the other internal organs, which have been reduced to a minimum.

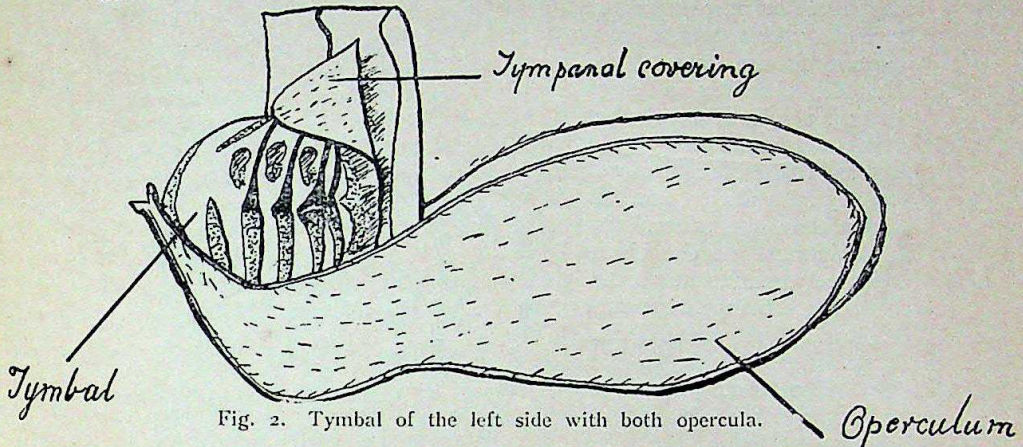


Fig. 2. Tymbal of the left side with both opercula.

If the fingers are passed over the abdomen of the cicada, it will at once be noticed how papery it is. Cut it in two longitudinally. It will readily be seen how empty the abdomen is—perhaps there are no internal organs! No! these are all reduced in size and are fixed to the dorsal region of the abdomen. In order that it may freely serve the purpose, it has now become a resonator—empty vessels make the most noise! The thoracic region is full of powerful muscles. The anterior part of the thorax is divided from that part which is continuous with the empty abdominal cavity, by a thin wall of chitin. In front of this wall are the muscles connected with flight and behind it one large, broadly conical muscle, the pair to this one is in the other half of the body. These two muscles are by far the largest muscles in the whole anatomy of this cicada and are devoted to the sole purpose of working the “instrument” with which these creatures make their “big noise” in the world. We shall have occasion to refer to these muscles later.

On either side of the abdomen in the present species there is a large obovoid plate constricted below the middle and then narrowed into the base where it is attached. These are the *opercula* (fig. 2). These plates are fixed and are not capable of any movement. They assist in directing the sound waves over the surface of the hollow abdomen, thus increasing the volume of the sound produced. Now we come to remove an operculum and cut away a portion of the abdominal wall to see this part of the apparatus in operation. At the basal end of the opercula, and partly covered by them, are two small highly convex structures composed of a thin flexible membrane reinforced with strongly chitinised ribs and plates of a reddish-brown colour. These are the *tymbals* (figs. 2 & 3). The tymbals are in a strong chitinous frame which borders them on all sides. The ribs and plates help to produce the sound and at the same time act as a spring, bringing the tymbals back to their

original position after deflexion. The tymbal is somewhat triangular, though it appears circular when in position on the insect. At the posterior margin of the tymbal, which would correspond to the base of the triangle, there is a large chitinous plate somewhat triangular in shape—this I propose to call the *plectrum* (fig. 3). This plate is larger than the others and the thickness of the chitin is varied at different points, the surface being somewhat undulate. At the dorsal angle of the triangle the chitin is extremely thickened in the form of a broad inverted Y (fig. 3, a). The top angle (that pointing in the direction of the head) has an obtuse *beak* (fig. 3, b)—the point of the plectrum. The other portions of the plectrum gradually fade away into the membrane of the tymbal. So much for the present about the externals of the "instrument", now let us have a look into the body. In the longitudinal section we noticed the large broadly conical muscle arising from the last segment of the thorax. This is the *tymbal-muscle* (fig. 4). It is surmounted by a thin chitinous

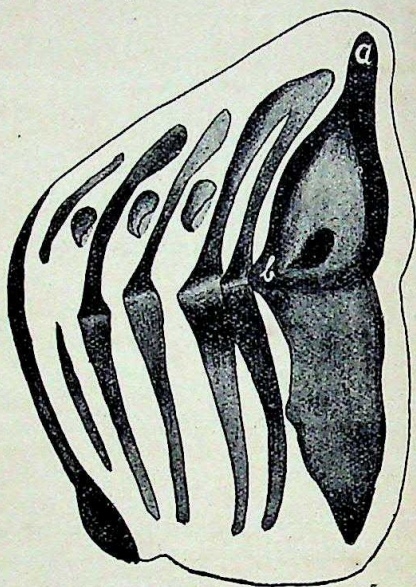


Fig. 3. A single tymbal showing chitinous ribs and plates. a. Y-shaped end of plectrum. b. Point of plectrum.

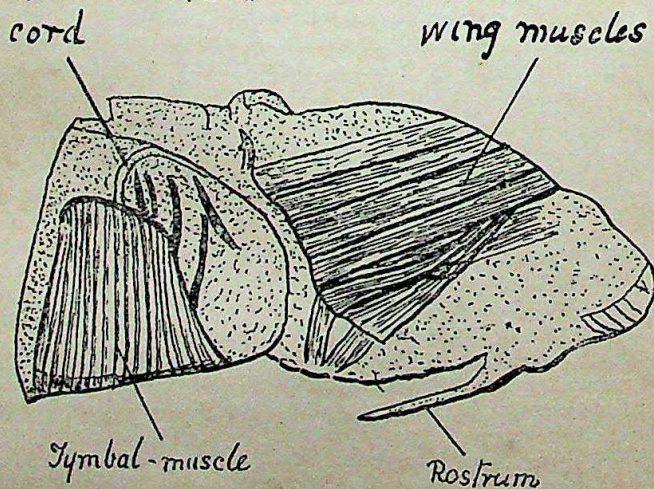
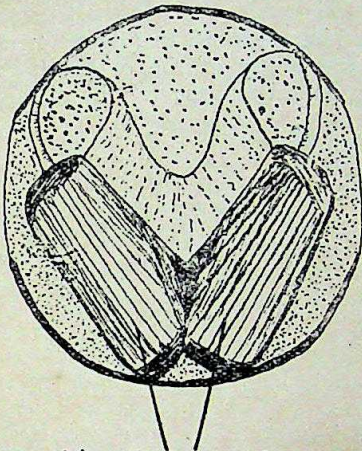


Fig. 4. Longitudinal section showing the muscles.

plate on the top of which is a thin chitinous cord. This cord is attached to the stem of the thick Y-shaped angle of the plectrum, already referred to. In cross section the tymbal-muscles are seen to be united at their bases, but the upper portions diverge from one another in the form of a V (fig. 5). They are the largest muscles in the body and are composed of a bundle of muscle strands, giving them a striated appearance.

Let us examine the outside of the tymbal once more. As we



Tymbal - muscles

Fig. 5. Section showing both tymbal muscles.

have seen, there are chitinous ribs and plates on its surface. The ribs are important and call for our attention first. There are four in number crossing the surface of the tymbal. In their upper half they are more chitinous than in the lower, particularly at the centre. The two anterior ribs are free, but the two posterior are united at the top and at the middle forming a solid mass, the lower ends are free. When the tymbal is deflexed by the contraction of the tymbal-muscle, the upper portion of the tymbal alone (about $2/3$) is deflexed. On relaxation of the muscle the ribs spring back to their original position. Now to follow the action of the whole apparatus. When the tymbal-

muscle is contracted, the cord which is attached to the plate on the top of the muscle is pulled. The other end of this cord is attached to the stem of the Y-shaped angle of the plectrum. This tension deflexes the plectrum, the beaked (or anterior) angle of the plectrum crosses the thickened portion of the fused ribs, at the same time the rest of the tymbal is deflexed. When the beak of the plectrum crosses the fused ribs there is a click and when the muscle is relaxed the same click is repeated, just in the same way as a true plectrum is used on the string of a banjo. Now in the cicada the tymbal-muscle contracts and relaxes at a tremendous speed bringing the plectrum into play as described above, thus giving rise to the noise made by the cicada. The sound waves are conducted over the hollow abdomen by the opercula. They function in much the same way as a hand placed above the mouth of a singer can increase the volume of sound. Thus the clicking sound is magnified to the tremendous din.

In order to verify my observations, I performed the following experiments with living cicadas. I might mention here that this particular species does not modify its production when handled. In the first place I was anxious to see whether one tymbal was able to operate without the other. With this object in view, I first obstructed the action of one tymbal—the other continued to func-

tion. I then cut out the tymbal of one side—the result was the same. Lastly I injured the tymbal-muscle of one side with a like consequence. The next point that drew my attention was the opercula. Partial removal of one or both had no perceptible effect on the volume of sound, but when both were entirely removed there was a slight change in the volume of sound. In the next experiment I made a hole in the abdomen with the effect that the sound was considerably modulated. With the removal of the entire abdomen, the sound was reduced to a minimum—it was a little more than just audible.

The result of the experiments are thus reduced to (a) one tymbal is capable of producing sound independently of the other; (b) the opercula are only conductors of the sound waves; (c) the abdomen is reduced to a resonator.

REVIEWS

I. BIRD LIFE IN INDIA by Captain R. S. P. Bates, M.B.O.U., x + 187 pp., 9½ ins. × 7 ins., with a map and sixty-two black and white plates, and frontispiece. Published by the Bombay Natural History Society. Price Rs. 9. (to members Rs. 6-12)

The untiring efforts of the Bombay Natural History Society to promote an intelligent interest in all branches of natural history in this country are too well known to need special comment. Witness for instance the numerous excellent publications it has placed before the public in recent years including, among others, the charts for the identification of poisonous snakes, the Butterfly book by Col. Evans, the sumptuous volumes dealing with the game birds of India by Stuart Baker, and the sets of charts illustrating in colour over 200 species of the commoner birds of the Indian plains. To this creditable array has lately been added the book under review.

Captain Bates, the author, is familiar to all readers of the *Journal* through his beautifully illustrated and charmingly written articles on Indian bird life which appear in its pages periodically—though unfortunately not as often as we should like to see them. As pointed out in the preface, a great part of the subject matter of the 11 chapters that go to comprise the book is a re-casting of the articles that have appeared from time to time in the Society's *Journal*, and among the illustrations likewise readers will recognise a number of old friends. Their publication in book form, with the addition of hitherto unpublished material both in the letterpress and photographs will, we trust, serve to bring the fruits of Captain Bates' painstaking observations and infinite patience before a still wider circle of readers. Popular works on Indian Natural History are few and far between and we are sure all nature lovers will welcome the advent of this publication.

The fascinating sport of bird photography in India, despite the almost unparalleled facilities the country offers as regards lighting conditions and abundance of bird life, is still in its infancy. It undoubtedly presents a great many difficulties, besides which the climate, especially in the plains, is a factor to be seriously reckoned with when working from a hide. The last two chapters of the book entitled 'Experiences with Natural Hides' and 'A Bird-Photographer's Needs' are particularly illuminating, and we would commend them particularly to those about to begin, or have abandoned in disgust or despair, the hobby of photographing Indian birds. Captain Bates' achievements entitle his hints and suggestions to the right of being treated as authoritative, and his photographs demonstrate the high degree of success that can be attained through patience and attention to detail.

We heartily commend this book to every nature lover in general and to every bird-photographer in particular, be he old or young, would be, successful or otherwise, and are sure that all will read it with pleasure and profit.

A word of praise is due to the printers of the plates, the *Times of India Press*, Bombay, whose name we find has been inadvertently omitted on the title-page. The reproductions of the photographs are excellent and reflect great credit on the Press.

The only fault we have to find with the book is in its binding, a defect all the more deplorable since in the line of popular natural history works the get-up plays a most important part in the selling-power and circulation of a book. In these days of financial depression, however, it was imperative for a work that would be popular to be at the same time inexpensive, and it cannot be denied that the price fixed for this book, embellished as it is with such a large number of plates, brings it within the reach of all. We hope it will meet with the success and popularity it deserves.

S. A. A.

II. DIFFICULTIES OF THE EVOLUTION THEORY by Douglas Dewar. Published by Edward Arnold and Co., London.

The author has clearly been very much impressed by Vialleton's 'Morphologie générale' and in the course of compiling the present volume (I use the term compiling deliberately, for a large part of the book consists of abstracts or

quotations from other authors) has clearly read a number of works on various branches of science. Unfortunately, the result appears to be a kind of mental indigestion.

At the outset one is faced with the difficulty of discovering what exactly Mr. Dewar means by the term evolution; so far as I have been able to discover, the author would apply this term solely to those cases in which the change from one form to another has been by gradual and almost imperceptible stages, i.e., evolution in the strictly Darwinian sense, whereas changes that have been brought about somewhat abruptly, as by mutation, he would regard as creations. A close study fails to show whether Mr. Dewar agrees with and accepts the time-honoured dictum *Omne vivum ex vivo*, or whether he genuinely believes that each main phylum and even some of the smaller groups in the great biological kingdom have arisen as special creations, using the term in its generally accepted sense to mean the creation of a living organism by supernatural powers out of non-living material. At one time he appears to hold this latter view, namely that 'each creation is the embodiment of a divine idea, or that organisms have been created out of nothing by the mere fiat of the Creator'; but in other places he seems to regard 'the rearrangement of the structural elements of some earlier organism or a change in the development of some embryo' as an act of creation. In his definition of a special creation as 'a new kind of organism which has had an abrupt origin or made a sudden appearance, as distinguished from a gradual transformation through successive generations of some earlier organism' the author tries to so widen the ordinary meaning of the term 'creation' that it can be used to include, on the one hand, the formation of a complex living organism out of nothing or at least out of non-living matter, i.e., a miracle, and, on the other, those mutations that, one knows, occur in nature and that can be induced experimentally in organisms by the application of some unusual environmental condition, such as X-rays or a modified food-supply. Every biologist will agree that, so far as the geological record goes, new types make their appearance suddenly in the succeeding strata; but that is a very different thing to believing that because their appearance is sudden these types have been specially created; and no one with an adequate realisation of the intermittent manner in which these fossiliferous strata have been laid down and the thousands of years that may have elapsed between the deposition of one stratum and that immediately preceding or succeeding it, would be so surprised, as Dewar appears to be, that 'the fauna and flora of a horizon differ very markedly from those of the horizon immediately below'; neither would they accept Mr. Dewar's final summing up (p. 155) that 'the correct scientific attitude, in the present state of knowledge, is to recognise that in the past new types have made an abrupt appearance, and to admit frankly that at present we are quite unable to point to any natural forces capable of originating them; in other words, to revert to the theory of creation,' nor that it appears 'to be necessary to adopt a provisional hypothesis of special creation, . . . supplemented by a theory of evolution.'

Much knowledge has been acquired since Darwin first postulated his great theory and it has been found necessary to modify the theory to some extent; the hope that future paleontological research would reveal missing links connecting the great phyla has been abandoned and it is now recognized that the evolution of these main groups took place at a very early stage in the history of the biological kingdom but it is also becoming more and more widely recognized that the further we go back in the past the more plastic were the then existing animals and plants; and it is probable that, correlated with the greater instability of the earth's crust and of the physical conditions existing thereon, this greater plasticity may have permitted those abrupt changes or mutations, that still occur even in the most highly specialised and therefore most fixed forms, to be of much greater range and importance, even of sufficient importance to have caused the mutation of one phylum from another. To seek for the origin of the great phyla one has to go back beyond the Protozoic era, but that is no argument in favour of adopting a belief in special creation.

The book contains some glaring inaccuracies; zoologists will be amazed to read that 'the structure of the pelvic (hip) girdle differs fundamentally in the two classes (Reptiles and Mammals). In Reptiles it articulates with the sternum (breast-bone) by means of the coracoids, and forms part of the thorax', and again, that 'the Reptiles have two aortae; the mammals have but one—the right'.

R. B. S. S.

MISCELLANEOUS NOTES.

I.—LOCAL MIGRATION OF THE FLYING-FOX
(*PTEROPUS GIGANTEUS*) IN THE PUNJAB.

The Flying-Fox (*P. giganteus*) remains in the Gurdaspur District of the Punjab from March up to the end of the fruit season.

This year the first arrivals were seen by me on the 3rd. of March. They are not very numerous as yet—food is not plentiful—plums and *Bombax* are the only trees that provide them with food. Later they will be in thousands.

GURDASPUR,

PUNJAB.

March 18, 1931.

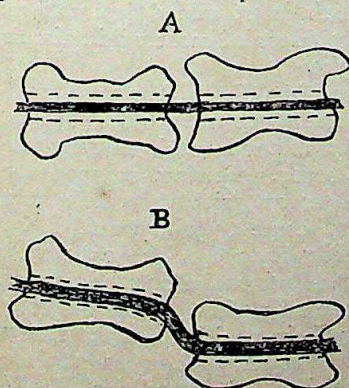
G. BREADON,

District Engineer.

II.—VITALITY OF A COW MAULED BY A TIGER.

(With two text-figures).

A case of a cow that was scragged by a tiger, and then ran about 40-50 yards with a broken neck before it collapsed dead occurred near here recently. The kill, a natural one, was the work of the fifth tiger (rather tigress) of the group of five I recently had the fortune to bag. I was shown the spot where the tiger had obviously first felled the cow (signs of the struggle, blood, and hair were there in plenty), and then 40 or 50 yards below the kill itself, a cow in its prime, with neck broken. This was interesting, and on writing to Major P. T. Saunders, Director of Veterinary Services, Madras, on the matter I received the following reply:—'I have your letter with the query about the cow with the broken neck. It is really most interesting but is certainly possible. Had the neck been broken, i.e., with displacement of the parts, the cow could not have run 50 yards, as pressure on the spinal cord would mean loss of both sensation and control. In my opinion what occurred was that the "break" took place where the tiger tackled her but displacement of the parts was not immediate and took place later. Imagine Fig. A showing two neck bones, the dotted lines showing the canal for the accommodation of the cord, and the dark part the cord itself. The dislocation of the joint might occur and the parts still remain in position. Then by a muscular action of the cow's neck the displacement (actual dislocation) takes place later thus etc., holding the joint in position



(Fig. B.). The ligaments etc., holding the joint in position

were no doubt destroyed at once. Similar cases have occurred in men.'

HONNAMETTI ESTATE,
ATTIKAN P.O.,
VIA MYSORE, S. INDIA.
March 3, 1931.

R. C. MORRIS,
F.Z.S., F.R.G.S.

III.—A PANTHER'S STRANGE BEHAVIOUR.

In December last a couple of panther (male and female) came to a kill R. E. W. of Madras and I were sitting up over, (time, 8 p.m.—moonlight). The male commenced to feed and was shot dead on the kill. The female immediately started to perform an extraordinary set of evolutions which lasted for about 10 minutes—rushing up and down across our front, kicking up an almighty din the whole time, seizing and shaking the kill and its dead mate, and repeatedly taking at a bound a high rock in front of us. We received the impression that had she discovered our presence on the small, lone tree we were on, she would probably have taken our machan at a bound too, possessed with the devil as she seemed to be. When she finally quietened down and cautiously approached the kill, a shot laid her low beside her mate—so in death they were not divided.

HONNAMETTI ESTATE,
ATTIKAN P.O.,
VIA MYSORE, S. INDIA.
May 18, 1931.

R. C. MORRIS,
F.Z.S., F.R.G.S.

IV.—CANNIBALISM IN PANTHERS.

Cases of cannibalism by the greater Carnivora have been occasionally recorded in the Society's *Journal*, but incidents of this nature are always of interest. The following is an account of a recent happening near Pachmarhi, which is of added interest, as a further indication of the well-known boldness of most wild animals during the hours of darkness and twilight.

Captain G. W. N. Barefoot, M. C. and Mr. B. M. Pratt write:—
“We were motoring down a ghat road about 11 o'clock on the night of June 6th, and by the light of a hand torch saw by the roadside the reflected light of several eyes. Having stopped the car, we searched about in the bamboo forest with the torch, and about two hundred yards from the road came to a dry nullah, on the further side of which there was rising ground. The eyes were now seen up the slope, but we were not able to make out the owners of them sufficiently clear for the purpose of a shot. Half an hour passed by without the beasts changing their position, so we threw stones, and made noises, in the hope of moving them to a place where Mr. Pratt placed himself in waiting. Eventually a No. 4 shot was fired in their direction which disturbed them, and after

about ten minutes, caused one of the animals to show itself about thirty yards from Mr. Pratt, who fired at it with his 12 gauge shot gun (lethal bullet). The animal leapt in the air, ran some yards, and then sound ceased. Throwing of stones produced no response, but it was thought best to leave the possibly wounded beast until the morning. The other two animals remained exactly where they were, hidden behind clumps of bamboo, and out of range, but after fifteen minutes their eyes were not to be seen. We returned at an hour before dawn, and approaching the place found one panther eating something where the body of the animal fired at should be; but on account of the darkness could not make it out clearly enough for a shot.

On our nearer approach it moved off, and we found our panther had been eaten. The skin had all gone from one side of the stomach, and there was a deep gash in the cheek; it resembled, in most respects, a natural kill, although the bullet must have killed it outright, having entered just behind the shoulders.

It was a male and measured 6 ft. 4 ins. Probably the party was a female with two almost fully grown cubs. We followed after the cannibal for some time, and saw two panthers moving rapidly up a dry nullah, but could not obtain a shot at them."

Mr. Pratt tells me he has killed 6 panthers during the past two years by spotting them with a torch from a car, and then following them up in the forest with gun and torch.

Until a shot is fired, and a hit made, there is probably but little risk in this method of panther shikar; but following the perforation of the target any kind of excitement may eventuate.

Long life to this young sportsman, who has shown the way to thrills which may attract even the most blasé of shikaris! The great majority of sportsmen condemn all shooting with aid of a motor car as unsporting; but so long as the shot is not taken with the direct aid of the car; but in the manner here indicated, it will, I think, be agreed that this method of coming on terms with tiger and panther may be considered permissible; provided, of course, that any beast wounded must be next day followed up in the usual way.

PACHMARHI,
June 12, 1931.

R. W. BURTON,
Lieut.-Colonel.
Indian Army (retired).

V.—SOME SUGGESTIONS ON PANTHER SHOOTING.

I do not know how far this will appeal to the sportsman in general, but as I have myself tried it many times and with success, I offer the suggestion for what it is worth.

It is not unusual that the bait tied up to obtain a panther kill is carried off by a Hyæna and much time, labour and energy is lost.

One method of circumventing the prowling hyæna is to tether the bait on a small machan, a rough platform, 5 ft. x 5 ft.,

raised on poles say about 4 ft. 6 ins. from the ground. If this is done hyænas will leave the bait alone and if a kill is made one can be certain that it is the work of a panther. The ground below the platform and for three feet around it should be cleared and, if sprinkled with sand, will reveal pug marks.

AMBIKAPUR,

P.O. SURGUJA, C.P.

June 10, 1931.

RAMANUJ OF SURGUJA.

VI.—THE NUMBER OF PUPS IN A WILD DOG'S LITTER.

With reference to Miscellaneous Note IV at page 1055 of Vol. xxxiv, No. 4, I have seen seven pups with a wild dog bitch which brought her family to a panther kill. A friend says he has seen ten pups with a bitch, but in both these instances it might be that the pups belonged to two mothers, though that is not likely. But another friend tells me that he himself saw seven embryos taken out of a wild dog which was shot. When he sees this note perhaps he will give the date (which I forgot to enquire) as evidence of the breeding season.

PACHMARHI,

June 28, 1931.

R. W. BURTON,

Lieut.-Colonel.

Indian Army (retired).

VII.—AN INCIDENT WITH WILD DOG IN NIMAR.

In March 1930, a friend and myself were the victims of an unusual encounter with Wild Dog. On the night of the 9th. and 10th., a bait, tied up at the junction of a cart track and a nalla which held several pools of water, was killed by a tiger whose pugs were clearly imprinted in the sand. Visiting the spot in the early morning we selected two trees for our machans, each about 30 yards from the kill, as we hoped to get a shot by daylight. We covered up the kill and left two men on guard to see that nothing was disturbed.

Early in the afternoon the shikaris were despatched to tie up the machans and we followed shortly afterwards in a bullock cart.

The last half mile of our road lay over an open maidan covered with short spear-grass and having here and there a thin clump of trees. As soon as we entered this maidan we came on a pack of Wild Dog, some dozen or more strong, lolling about under a clump of trees about 100 yards off the road. We stopped and debated whether or not to open fire, since, though we knew that to do so would probably ruin our chances of getting the tiger, yet we had good cause to suspect that it was due to the presence of these Wild Dog in our block that we had hitherto had no success and it seemed a pity to let the pests escape. Eventually, however, we decided against firing and moved on; the dogs, mean-while, had not taken more than a mild interest in our proximity. A few minutes

later, topping a slight rise in the ground, we sighted three or four nilgai bunched together in the open; these stood at gaze for a moment and then cantered off for the edge of the forest. I think we must have cut in between the dogs and their quarry.

On reaching our destination we found that our shikaris had seen nothing of the dogs on their way so it seemed unlikely that the latter would remain in the vicinity, but, to make certain of this we sent two men who had been on guard to drive them off in the opposite direction.

It was not long before we settled down to our vigil.

Before sunset our only visitors were a solitary langoor and a couple of peafowl; but as soon as the full moon was flooding the open grassy stretches with silver light, the teak-clad slopes of the low hills to my front began to rustle with the movements of sambar coming down to drink at the pools a hundred yards or so behind me. Soon small groups of deer could be seen silhouetted against the silvered grass.

Next a rustling in the grass from behind my friend's machan set my pulse beating, but, after an eternity of waiting, it materialized into a *chausingha*, or four-horned antelope, also on its way to drink. The little creature made a tremendous clatter moving down the stony nala-bed, as if it had not an enemy in the world.

The hours dragged on and the sambar were back again in their hillside and I was brooding on the many disappointments of shikar, when the silence of the night was rent by a deep and throaty snarl, some distance away. After what seemed an age two small black shapes trotted out of the long grass and made straight for the kill. At first I thought they were jackal; but, when, after a sniff at the carcass, they retreated only to return in a moment, followed by the remainder of the pack, and without further ado fell to tearing at the kill, it was clear enough that we had not seen the last of the Wild Dog.

All other means of persuading them to decamp having failed, I fired 'into the brown' which had the effect of making them scatter, but not by any means clear out. In a minute or two the bolder ones were moving back to their interrupted meal. Again I fired, again without recording a hit, but this time they seemed to have had enough and disappeared.

We now gave up all pretence of keeping quiet and discussed the situation and the *pros* and *cons* of a proposal to return to camp; before, however, we had come to an agreement on this point, we were interrupted by a commotion arising on the hill slopes whence the sambar had come earlier in the night.

The sound grew rapidly closer and now above the noise of the stampede rose a frenzied whimpering cry. I have only heard Wild Dog give tongue once before and on that occasion we had surprised two drinking and my friend bowled one over and the other circled around out of sight calling—quite a different call. Perhaps what we now heard was the cry of pups as we had noticed some half-grown ones with the pack in the afternoon.

A few minutes later a confused black mass of flying shapes came out into the moon-light, heading straight towards us, and,

ceasing to advance when exactly opposite my friend's machan, began to revolve, as it were, on its own axis.

After a bit I made out a sambar in the middle of the *mêlée*, and my friend, who was closer and could see better, shouted that the dogs were pulling down two sambar and that he was going to fire.

Two shots crashed out and a sambar hind plunged off past me and away. My friend reported that he had missed with both shots but that the dogs had cleared leaving one sambar apparently dead; but whilst we were still talking the poor brute staggered to its feet and came tottering towards me. It paused for a moment under my machan and I turned my torch on to it but could see no trace of wounds; then it slowly made off towards the pools behind.

Poor brute! We wondered what would happen to it and we were not long in doubt. We heard it bell from the water and once again the whimpering cries arose. Then came a scream followed by awful moans of agony as the wretched creature was torn to pieces.

At dawn we visited the pools and found the signs only too clear to read. A scoop in the sand at the edge of the deepest pool showed where the sambar had been dragged forth. Higher up the bank the boulders were stained with blood and here lay the stomach and there six inches of the tip of its tail.

AHMEDABAD.

R. M. SIMMONS.

March 23, 1931.

VIII.—THE MITHUN.

Your correspondent in the last issue of the Journal, through ignorance of the Assamese language, does the Burma Forest Department an injustice, when he accuses them of jesting at the expense of the shikari, in issuing a permit to shoot *mithan*. The Assamese use the word *mithun* (not *mithan*: the name is spelt correctly by Carey and Tuck in the *Gazetteer of the Chin Hills* and by Sanderson, in *The Wild Beasts of India*, but wrongly by your correspondent and most other sporting writers, including Lydekker in *The Game Animals of India*) indiscriminately, when speaking both of *Bibos gaurus* and *Bibos frontalis*. In fact, to most Assamese the word would probably call up the image of the *Bibos gaurus*, as only those living near the hills on each side of the Brahmaputra Valley have seen *Bibos frontalis*. Probably the list of protected animals and permit to which your correspondent takes exception were drawn up by some Conservator who had served in Assam.

Among the Kuki tribes inhabiting the Manipur Hills the *mithun* was, until recently, the only bovine domestic animal. Together with the gong and cornelian beads, it constituted their currency, and penalties for breaches of their primitive code of laws, as well

as the price of wives, were calculated mostly in so many head of *mithun*.

The Chins (who are closely related to the Kukis) are probably correct in making the *Bibos frontalis* the offspring of *Bibos gaurus* and domestic cattle, although it has now become a separate species. The Kukis practically cleared the Manipur Hills of bison upwards of half a century ago, and mating of *Bibos gaurus* either with *Bibos frontalis* or domestic cattle is quite unknown nowadays. But *Bibos frontalis* is a fertile species, and breeds freely. The bulls also interbreed with domestic cows. Crosses are not uncommon among the Naga tribes of the Manipur Hills, who keep cattle as well as *mithun*. I have never known the crosses to interbreed with each other or with domestic cattle in these hills, but I knew a case on the Kuturi Tea Estate, in the Nowgong District of Assam, where a cow, bred from a *mithun* bull from the Aka Hills and a domestic cow, bore a calf to a domestic bull. I have often wondered whether the sturdy black cattle kept by the Naga tribes in these hills do not possess a strain of *Bibos frontalis*. I met one instance of a cross between a bull of *Bibos frontalis* and a domestic buffalo cow. The animal could hardly be distinguished from a pure-bred buffalo. I never ascertained whether it interbred with buffaloes.

It is not correct to say of the *mithun* of the Manipur Hills that "all the domestic cow's varied colours appear". They are all black and white, as in your correspondent's excellent photographs (calves are brown and white until they are a few months old, when the brown changes into black). The majority are coloured like *Bibos gaurus*, with black bodies and legs and white stockings, but a number are piebald, though always in black and white. Occasionally the white prevails over the black.

The *Bibos gaurus* is not always "a very silent beast". I remember taking a friend out in a remote forest in Nowgong, where *mithun* (bison) were very plentiful, and we were surrounded by animals bellowing loudly in the early morning. Sanderson rightly describes the noise as follows:—"It closely resembles a common sound made by elephants. It is used by bison to call each other at a distance, and can be heard for about a mile in favourable ground. It may be described as a sonorous bellow". Not unnaturally, it even more closely resembles the sound made by *Bibos frontalis*.

I have never had the misfortune to encounter a savage specimen of *frontalis*. In return for a little salt they will usually follow one about the village.

THE RESIDENCY,

IMPHAL,

MANIPUR STATE.

July 27, 1931.

J. C. HIGGINS,

I.C.S.

[The spelling of the word "mithun" as "mithan" in Mr. Livesey's recent note was due to the Editor's following the spelling adopted by Blanford in the *Fauna of British India, Mammals*. Eds.]

IX.—THE SHWE-U-DAUNG GAME SANCTUARY,
UPPER BURMA, WITH A NOTE ON THE ASIATIC
TWO-HORNED RHINOCEROS (*R. SUMATRENSIS*).

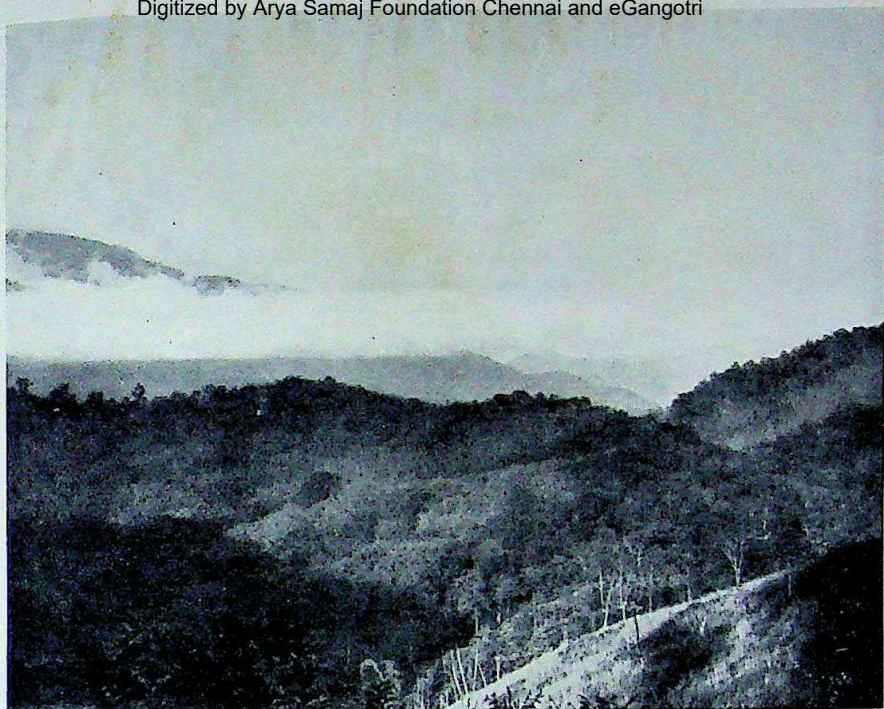
(With a plate.)

I enclose some notes and photographs taken by me during a fortnight's tour in the Shwe-u-daung Game Sanctuary in Upper Burma. They may be of interest to readers of the Society's Journal.

The Sanctuary extends over 126 square miles; 75 per cent of which is heavily afforested. The more elevated portions of the Sanctuary assume the form of a high watershed which stretches for about 10 miles at altitudes varying from 4,000 ft. to 6,223 ft. on the Shwe-u-daung peak. The main peaks, the ridge, and most of the high spurs leading from it are partly or altogether bare of tree growth over considerable areas. They are covered by a coarse grass which is from 1 to 3 feet high on the higher slopes; but this gives way to very high *kaing* grass in depressions and on the borders of the forests which clothe all the lower portions of the Sanctuary. The climate on the main ridge is cold and bracing, and with the exception of a few blood-blister flies most of the insect pests found lower down are absent.

The three main peaks; Shwe-u-daung, Nanmadawgyi, and Nanmadawgalay are popularly supposed to be the abode of certain *Nats* (spirits,) which are held in some reverence by the Shan villagers near the Sanctuary, and serve most opportunely to preserve the sanctity of this stronghold of wild game. It is an area the high ground of which is eminently suited to be a National Park of the future. The transition to this desirable end must be gradual; but it is hoped that it will not be very long before the communications are improved and this area made available as a resort of every lover of nature and wild animals.

All species of animals indigenous to Northern Burma with the exception of Thamin, Goral, and Hog-deer are found within the Sanctuary. Saing (*Bibos banteng*) are found on the low ground in the western parts of the Sanctuary but do not climb high into the hills. With this exception, all the species may be found in due season on the open grassy slopes on and near the main ridge. During my visit from October 24th to November 6th the grass was too coarse to attract Bison to the main ridge and only one herd of 15 was seen out in the open. Sambhur, however, were plentiful and were on view in the open at all hours of the day in herds of from 3 to 10 individuals. They are not shy; but being unaccustomed to the sight of human beings desert the open ground for a few days after seeing men. This fault can be easily set right during the transition stage between a Sanctuary and a National Park. In March to May the numbers of animals on view would be far greater.



THE SHWE-U-DAUNG GAME SANCTUARY.



CC-0. In Public Domain. Gurukul Kangri Collection, Haridwar
THE ASIATIC TWO-HORNED RHINOCEROS (*R. summatrensis*), SHOT IN THE SANCTUARY.

Experience in other countries has shown that in order to persuade wild animals to remain on view in the open, they must be made accustomed to the sight of men. In my experience in the Sanctuary, areas in which animals were seen on the first day were deserted on the next, and this is bound to be the case in an altogether secluded area. The regular patrolling of the Sanctuary by reliable keepers and the gradual construction of paths and buildings will, far from disturbing the game, make them indifferent to the sight of men.

Heavy mists are the rule at high elevations within the Sanctuary during the rains and the early part of the cold weather. During more than half my time in the Sanctuary photography was at a discount owing to mists and some rain. During the dry season however and especially in March, April and May, the Sanctuary would be a paradise to the keen photographer of wild animals.

One tiger was seen right out in the open. They are splendid creatures; but disturb the deer on the main ridge and should be destroyed.

In addition to a large number of sambhur, I saw within a fortnight three rhinoceros, one solitary bison, one herd of fifteen bison, one tiger, one elephant, one barking deer and six pigs.

The accompanying photograph is of a male Two-horned Rhinoceros (*Rhinoceros sumatrensis*), shot within the Sanctuary under the direction of the Local Government for museum purposes on the 27th October, 1930. The skin and skeleton have been presented to the British Museum for mounting.

The destruction of this animal is less to be deplored than might be apparent, as there are fully ten other rhinoceros living in the Sanctuary under conditions ideal for their continued existence and increase. The specimen depicted measured between pegs 9 ft. 5 ins. in length and 4 ft. 5 ins. in height: an average male with much rubbed and worn horns of which the front horn is 7 ins. in length along the curve from base to tip.

R. sumatrensis spends most of its time in the heaviest forest it can find and only occasionally climbs onto the open grass-clad ridges and spurs which are a feature of the Sanctuary at elevations above 4000 feet.

There is still some hope that a specimen or two of the Lesser One-horned Rhinoceros (*R. sondaicus*), is to be found in the Shwe-u-daung Sanctuary. Tracks measuring 8½ ins. in diameter have been seen which correspond nearly to those of *R. sondaicus* in Mergui and Thaton in southernmost Burma. The tracks of the specimen of *R. sumatrensis* shot in this Sanctuary were a shade less than 8 ins., and I am afraid the animal responsible for the larger tracks will be found to be merely a larger specimen of the same species.

There appears to be no marked variation either in structure or habits between the specimen shot in the Shwe-u-daung Sanctuary and a couple of others shot by me about 8 years ago in the angle between the Uyu and Chindwin rivers. One of the latter was, however, a foot longer and 4 inches higher than the former.

Rhinoceros sumatrensis wander generally in pairs, and a former

experience was duplicated in that the mate returned to the body of the one killed a few minutes after the shooting, and had to be driven off by a shot fired over her head. They appear to have a fair share of the pugnacity attributed to their African relatives, and are not the kind of animal one would care to meet at very close quarters when unarmed.

The Rhinoceros in the Sanctuary conform to the practices common to the species of making sometimes quite large collections of their droppings; wallowing frequently in liquid mud, and breaking down and twisting small saplings along the routes favoured by them. On one occasion I saw a small sapling that had, in some amazing manner, been twisted into a simple knot.

The protection afforded to the Sanctuary has taken the form of legislative rather than practical measures. There are no Game Keepers, unless one includes in this meaning the monthly visit of one or two foresters; no roads and no buildings. No signs of poaching were noticed either on the ridge or the lower ground at the wallows and licks. When one considers that a Rhinoceros is worth to the average poacher at least from 20 to 40 times his monthly income, the comparatively large number of Rhinoceros existing in the Sanctuary is a very great tribute to the law-abiding nature of the population surrounding the Sanctuary.

MAYMYO,

E. H. PEACOCK.

February 15, 1931.

X.—BIRD MIGRATION NOTES FROM PORT BLAIR.

I have only very recently had access to Stuart Baker's completed edition of the *Birds of British India* and find that information is still required on many points to do with not only the rarer but even the common birds of the Andamans and Nicobars. I already knew that both the British Museum and the Bombay Natural History Society require skins of almost all birds from this region. I am myself leaving Port Blair before long but hope to find some resident here who will take up local ornithology and supply what is needed in the way of material as well as of information.

The Koel appears to be an immigrant. Which race have we got and what is its line of entry? In Port Blair, the Koel is first heard (but seldom seen) about October 7th, when he gives out short and timid notes about dusk as though to enquire whether any of his friends have also arrived and are lurking about. By December he and his wife are noisy and assertive. They seem to disappear in March. I have frequently visited the Nicobars in the second half of September and have found the Koel there well established as far as noise and bustle go. Is the line of migration through the Nicobars to the Andamans and if so is our race *malayana*? A comparison of female skins would settle the point. I have in much wandering only seen one male Koel after April. Perhaps it was a young bird without the migratory feeling. Every South-West monsoon there are a few Curlew, Whimbrel and

Eastern Golden Plover left behind and ornithologists in England have told me that this is common with immature birds.

There are also a few snipe to be flushed, very tame, in May and June and possibly these are the birds one shoots in early September. My shooting book shows that a few snipe are to be had in young rice during the middle of September and that there is often a period from about September 20th to October 20th when one may walk the most likely ground in vain. Then a favourable moon or some other weather factor brings the birds in thick. On the other hand in two seasons they have come in well about September 20th. Once arrived do they stay in Port Blair or move on elsewhere and make way for others? Generally the snipe grounds are pretty dry by December 15th and snipe hard to find. In 1926, however, 20 inches of rain fell between the 21st and 25th of December and the paddy stubbles in the east of the Settlement again filled with snipe and three weeks splendid shooting followed. Where did all these birds come from? Not from the western area which is later than the eastern but which could hardly have supplied so many snipe. Were they migrating birds passing over? This seems the more probable solution. What factors govern a good and a bad year for snipe? 1928-29 was good in Port Blair. On November 19th, 1928 another gun and myself got 50½ couple which is a local record. On the same day a year later, I walked the same ground, much of which was in prime condition, saw three snipe and killed one. It is to be remarked that in 1929-30 there arrived in Port Blair an immense number of Pale Harriers (*Circus macrourus* B. & O.). Every patch of rice had one of these birds over it. They also arrived in Stewart Sound, 90 miles North of Port Blair, some time in November and sat about on fences and trees in great numbers, apparently exhausted. Did they frighten away the snipe? The snipe season of 1930-31 was fair and there were no Pale Harriers about. But even in 1930-31 there was a complete absence of snipe in some places where in the past they have been very plentiful. Just at Christmas time, 1930, there were some 4 or 5 days of heavy rain and I looked forward to repeating the happy shoots achieved in January 1927 but the reconditioning of the ground was quite without effect and I walked over miles of attractive looking paddy swamp and hill side in January 1931 to find them completely devoid of birds.

On the night of the 24th of December after some days of high winds from the South-East a Petrel took refuge in the Settlement Mess from where I took it home quite unhurt sitting on my open palm. I left it for the night in a chart cupboard where it immediately got inside a rolled-up chart. Next morning when put on the table it at once took cover in a narrow crack left by me for the purpose in a pile of books, thus behaving as described on page 301, Birds, Volume vi, (new edition) *Fauna of British India*. The bird corresponded with the Dusky-vented Petrel, *Fregetta tropica melanogastra*, in measurements and colouration except that it had no white markings whatsoever, barring the extreme bases of certain feathers being white. I took the bird out on my hand after breakfast and as we encountered the South-East wind still

blowing freshly it began to collect itself for flight and suddenly was gone, flying in a zigzag course into the teeth of the wind at great speed. While on a flat surface such as the table or when in my open hand it was strangely fearless, just gently mouthing at my finger if placed near its beak. A very interesting visitor.

PORT BLAIR,
ANDAMANS.

M. L. FERRAR, *Lieut.-Colonel,*
Chief Commissioner,
Andaman & Nicobar Islands.

XI.—THE INDIAN GREAT REED-WARBLER.
[*ACROCEPHALUS STENTOREUS BRUNNESCENS*
(JERDON)].

The recent discovery of the Great Reed-Warbler in the Mangroves of Rewas across the harbour from Bombay has led to a request from the Society that I should examine and report on the specimens of this species in their collection.

The Rewas specimen was collected by Mr. Salim Ali on the 2nd April, 1930, and he noted that the birds were noisy and numerous in the mangroves while the testes of the male were sufficiently large to suggest that the birds were at their breeding station. The question immediately arose therefore whether the birds belonged to the race *brunnescens* which breeds in Kashmir and westward to Transcaspiæ or to the race *amyæ* to which in the *Fauna* vol. ii, p. 390, the breeding colonies of the plains of India are attributed.

I have taken this opportunity therefore to go into the whole question of the status of these two races in India.

Three of these Great Reed-Warblers have been described from within our limits:—

Agrobates brunnescens Jerdon, *Madr. Jour. Lit. Sci.* vol. x, p. 269 (1839—Trichinopoly).

Calymodyta meridionalis Legge, *S.F.* vol. iii, p. 369 (1875—Ceylon).

Acrocephalus stentoreus amyæ Stuart Baker, *Bull., B.O.C.* xliii, p. 17 (1922—Hessemara, Assam).

The first name of course applies to the bird which has been so well known ever since Jerdon described it nearly a century ago and which ornithologists in India for many years considered could only be a winter visitor to India though it was known to breed in Kashmir.

The other two names owe their existence to this belief in *brunnescens* as a winter visitor. Legge discovered that a Great Reed-Warbler bred and was resident in Ceylon and jumping to the conclusion that it could not therefore be the same bird as the winter visitor separated and named it on differences which Hume immediately shewed to be non-existent.¹

¹ Wait (Birds of Ceylon) is inclined to believe that the breeding form of Ceylon should be called *amyæ*. But if the Assam and the Ceylon birds were the same and were separable from *brunnescens* both would be called *meridionalis* by the rule of priority.

Then when several zoologists discovered that a Great Reed-Warbler bred in the Gangetic plain history repeated itself and *amyæ* was separated and named on distinctions, which I shall show, no more hold good than those of *meridionalis*.

Turning to the original description we find that *amyæ* is there described:—"A small dark form of Reed-Warbler, similar to *A. s. brunescens*, but decidedly smaller and darker. In this race of *A. stenoreus* the under surface is darker and more richly coloured than *A. s. brunescens*, and so marked is this that breeding birds of the new race in breeding plumage are darker even than winter specimens of that bird."

Disregarding the point that the worn breeding plumage of a Great Reed-Warbler is usually darker in tone than fresh winter specimens—had the fact been the other way round it would have been of importance—there is one serious objection that this race has been named on a single specimen. The type cited is ♂ no. 12-4-05. Stevens, Coll. no. 2650 and it is now in the British Museum. This bird is referred to in *J. B. N. H. S.* xxiii, 247 as follows:—"Secured in heavy reed jungle at evening, single record only." At the time there was no reason to believe it a breeding bird at all. Later on however, when Mr. Stevens was, as he says (*J. B. N. H. S.*, xxix, 1015), examining his Assam collection afresh it became evident that the eggs of Reed-Warblers obtained on the "Churs" of the Subansiri river belonged to two forms, a large and a small. As skins of two species, a large and a small, had been obtained (though only one of the latter had been actually shot upon eggs) it was assumed that the eggs belonged to the two species in question. As *brunescens* is found as a migrant well into May it is obvious that there is not any necessary connection between this April bird (of which the organs are not recorded as in breeding condition) and eggs found in the local reed beds.

This single bird I cannot separate in any way from *brunescens*. In colour, I can exactly match it with a Kashmir breeding bird, whilst in size I can match it with many specimens of *brunescens*.

In the description, its wing is given as 81.5 mm. Mr. Stevens himself (*loc. cit.*) credited it with a wing of 83 mm. I personally measured it as 83.5 and that was independently verified for me by Mr. Kinnear in ignorance of my result.

A. s. amyæ must therefore be considered as a synonym of *A. s. brunescens*.

In the course of my enquiry I took the opportunity to collate the records of *A. s. brunescens* for our area and to go carefully through all available specimens. It may be of interest to put the results on record.

The first point that has emerged is that the Great Reed-Warbler is far more widely spread as a breeding bird than the *Fauna* recognises. *Brunescens* is said (*Fauna*, ii. 389-390) to breed in Kashmir and Garhwal whilst Bahraich, Gonda and Assam are given for *amyæ*.

I find however, the following records, working from west to east within our limits. In British Baluchistan, it breeds at the Kushdil

Khan Lake, on the Lora River and near Quetta (*J. B. N. H. S.*, xxxi, 696), in Sind on the E. Narra (*Ibis*, 1922, 548), in the N.-W. F. Province near Dundar in the Kurram (*Ibis*, 1909, 119) and possibly in the Kaghan Valley (*J. B. N. H. S.*, xxiii, 104). In the Vale of Kashmir it of course breeds in immense numbers. In Gurdaspur district there is a huge breeding colony on the Kershopin jheel (*J. B. N. H. S.*, xxiv, 602.) The authority for the statement that it breeds in Gharwal I have not found.

From here there is a gap in the records, but specimens in the British Museum from Delhi (Bingham, 1st August), Moradabad (June, Hume Coll.), and Theenguik (13th September, Brooks) all in worn breeding plumage, and Loyah Bridge (18th October, Hume Coll.) completing an entire moult all suggest local, breeding colonies. Be that as it may colonies are recorded from Bahraich (*J. B. N. H. S.*, xxviii, 755) and Gorakpur (*J. B. N. H. S.*, xxii, 535).

The evidence for the supposed colony on the Sabansiri River, N. Lakhimpur, has already been discussed. There is then a definite gap until we reach the Southern Shan States where eggs have been procured at Taungwhe (Wickham, *J. B. N. H. S.*, xxxiii, 824) and Inle Lake, Yaungwhe (Livesey).

Southwards there is no definite record until Ceylon is reached but Davidson (*S. F.* x, 307) thought that there was probably a breeding colony on the Tapti below Prakasha in W. Khandesh and Mr. Salim Ali's bird is very suggestive. Its organs on the 2nd April were far larger than those of migrants I have collected in May in the Punjab. That mangrove swamps suit the bird for breeding is known on the Mekran Coast and they probably nest in the mangroves of Karachi also.

It is unfortunate that the egg collectors who recorded the above nesting colonies did not trouble to collect a series of skins to verify their discoveries. Field preserved two birds at Gonda which are now in my collection. His nests were taken in May and June and again in July and August. So the male shot in August is doubtless a breeding bird. It has a wing of 79 but is terribly worn. The other bird (σ wing 84.5) was shot in March so does not necessarily but probably represents the breeding colony. An unsexed bird shot by him, also in March, in Bahraich has a wing of 84 mm.

Legge's two males from Ceylon (*S. F.* i, 488) on the other hand have each a wing of 86 mm., the Delhi, Moradabad and Theenguik birds mentioned above have wings of 93, 90, and 87 mm. (♀ , σ σ). The moulting wing of the Loyah bird does not admit of measurement.

Six males collected by me from the Kashmir colony measure 88-92 mm. I can see no difference in colour, except such as is due to abrasion, between Kashmir and plains birds, whilst the measurements quoted do not permit of any separation between the Kashmir and the Indian birds on size. A large series of measurements taken from non-breeding birds in India, on migration or in winter gives a variation in wing length from 79 to 93 for both sexes.

It is evident that we have no reason at present to separate the

plains' bird from the Himalayan. I am not prepared to accept as a reason the small measurements of a small series of eggs, or the statement that the nests looked small, more especially bearing in mind my warning (*Ibis* 1928, 451), that *Acrocephalus agricola* will probably prove to be a breeding bird of the Indo-Gangetic Plain.

It is not impossible, however, that the Great Reed-Warblers which breed in the Southern Shan States may prove to be separable. There are three specimens available in the British Museum:—♂ 24-4-25 Taunggyi, ♂ 10-3-29, ♀ 22-3-29 Yaungwhe with wings respectively 81·5, 84, and 83·5. The Taunggyi bird would pass in colour as a Kashmir specimen. The other two are very close, but are perhaps darker, a more saturated colour above and a greyer, less fulvous-brown below. Should further breeding specimens confirm this difference separation will be possible.

It is difficult to define the status of the Indian Great Reed-Warbler very accurately. Like all jheel birds its movements are affected by the quantity of rain in any given year and by the burning and the cutting of the reed beds. Few observers have taken the trouble to record its status in their particular locality. It is at any rate established that whilst in parts of India the bird is a resident or a local migrant there is a great influx of winter visitors from Kashmir and the extralimital breeding range away to Transcaspiæ.

These birds can only be recognized from the records when they pour through the North-west on spring and autumn passage. Thus:—Kohat, 'common on migration from the end of March till well into June and again in August and in September' (Whitehead, *Ibis*, 1909, 119). Baluchistan, 'It is most noticeable on passage at the end of August and September and is apparently absent until April' (Ticehurst, *J. B. N. H. S.*, xxxi, 696). Karachi, Sind, 'passage migrants may be seen from the first week in September onwards ... they pass through again from mid-April, and the latest I have seen them is the 2nd May' (Ticehurst, *Ibis*, 1922, 549). These records could be further substantiated by a number of others, but it is unnecessary to labour the point, beyond remarking that on passage the Great Reed-Warbler is found anywhere, in crops, trees and hedgerows and gardens and is then not confined to the reed beds.

The breeding season in Kashmir, Baluchistan and India is from May to August.

CALBEC HOUSE,
BATTLE, ENGLAND.
May 1931.

HUGH WHISTLER.

[Mr. Salim Ali sends us the following extracts from his diary and states he is almost certain that the birds breed in the tidal mangrove swamp that flanks the neighbourhood of Rewas Pier and extends along the Dharamtar Creek. He made several attempts last year to procure nests and eggs from this locality, but owing to the nature of the terrain and density of the growth was unsuccessful.]

ful. Even officers of *bakhsheesh* were unable to tempt the local fisherfolk to search for them.

April	1,	1926:	Numbers present in the mangroves about the pier, calling in loud harsh notes from the tops of the bushes.
May	15,	1926:	Still present in the mangroves. Its voice appears out of all proportion to its size. It is a great ventriloquist. I should not be surprised if a breeding race is found in this part of India.
April	2,	1930:	Shot specimen while warbling from top of mangrove bush. Male*. Testes greatly enlarged: W. 84, Bill 19, Tar. 28 mm. Numerous in mangroves and noisy.
May	31,	1930:	Still present; plentiful and noisy.
June	26,	1930:	Still present; Males clambering up to exposed branches and warbling.
July	8,	1930:	Seen and heard. I am sure it <i>must</i> breed in the mangroves.
Aug.	2,	1930:	Still present. Warbling vociferously.
Aug.	8,	1930:	" "
Sept.	7,	1930:	" "
Sept.	28,	1930:	" "
Oct. 4 & 8,	1930:	" "	" "
Decem.	20,	1930:	" "
March	20,	1931:	Present in the mangroves. Warbling.
May	10,	1931:	" "
May	28,	1931:	" "

In addition to the above, Mr. Ali also observed the birds among the mangroves at Mahul (Trombay Island) on the 6th May 1931, and remarks that the males were exhibiting the same excited and noisy behaviour. Eds.].

XII.—COMMENT ON THE OCCURRENCE OF THE GREY HYPOCOLIUS (*HYPOCOLIUS AMPELINUS*) IN INDIA.

In the last number of the *Journal* (Vol. xxxiv, 1961), Mr. Salim A. Ali records the shooting of *Hypocolius ampelinus* and states that its occurrence in India seems to have been recorded only once before. Presumably he refers to the bird obtained by Blanford (Barnes' *Birds of Bombay*, p. 149).

In the cold weather of 1900-1901 I shot a specimen on the Gadaf Plain near Karachi and sent it to the Karachi Museum where it was skinned.

Further I sent a notice of this to the Bombay Natural History Society's *Journal* but as the notice was not printed apparently the matter did not seem worthy of record.

* This is the specimen referred to by Mr. Whistler in his note

As to Mr. Ali's letter about the casualties among the young of small birds perhaps pp. 164 and 165, Grey's *Charm of Birds* might interest him. There is put forward the view that the visits of a man to a nest help to show the nest to the robbers.

21, NORTHMOOR ROAD,
OXFORD.

PERCY HIDE.

April 5, 1931.

[On page 544 of his paper on the Birds of Sind (*Ibis*, July 1922) Dr. C. B. Ticehurst omits mention of the specimen procured by Mr. Hide. Evidently the skin no longer existed in the Karachi Museum when Dr. Ticehurst examined its ornithological collections. It is unfortunate that the occurrence of this rare bird within our limits should have escaped record in the Journal. Eds.].

XIII.—THE MAGPIE ROBIN (*COPSYCHUS SAULARIS*, LINN.) IN NORTH GUJARAT.

On page 84 of his *Popular Handbook of Indian Birds* Mr. Hugh Whistler writes: "Although said to be only a winter visitor to Mount Abu and Northern Guzerat, . . . etc.", I do not know who started this idea but it has absolutely no truth in it as the Magpie Robin is found in this district all the year round as will appear from the under-noted observations which I quote from my diary. The mistake seems to have been made by some official who in the hot season had failed to observe the presence of the bird because he himself retired to a hill station or because the bird left his usual haunts in the breeding season to build its nest in some secluded place. Otherwise it is impossible to ignore the Magpie Robin in summer as they are met with in all sorts of places and are found singing at all hours in the day.

My observations will show the occurrence of the bird in various places in and around the city of Ahmedabad in North Gujarat.

- | | |
|----------------|---|
| Aug. 31, 1930: | Saw a ♂ flying in and out of a lime tree in Shahi Bag. |
| Sept. 2, 1930: | In a neem tree near Grand Hotel, a single ♂. |
| Oct. 2, 1930: | In a bamboo clump near Gujarat College, a ♂. |
| Nov. 6, 1930: | A couple under a bush on way to Ashlali, five miles South of Ahmedabad. |
| Jan. 1, 1931: | Found a ♀ living in a bamboo clump in a private garden outside Delhi Gate. For about two months, I saw this bird daily at about 8-30 a.m. basking in the morning sun, perched on a branch. It disappeared in the last week of February. It was also observed in the afternoon at intervals. I never heard her utter a note. |
| Feb. 5, 1931: | I got a couple of ♀ birds for my aviary. They were caught near the Sabarmati Station (B.B. & C.I. Ry.). Ultimately I had to free them as they did not thrive in captivity. |

- March 15, 1931: Got another pair (this time a ♀ and a ♂). They were freed after a week's trial.
- April 30, 1931: Saw a ♀ bird feeding on ground in an alley near my house in the heart of the city.
- May 2-28, 1931: A pair built their nest near my house. I saw them every day—sometimes together, at other times singly—feeding on the ground in the company of Indian Robins (whom the magpie ♂ chases away at times), mynahs, house sparrows or warblers. Every morning, taking its perch at the highest point of a house nearby, the male sends forth its beautiful music, whose liquid notes float softly in the cool morning air. This is their breeding time and they do not seem to tire of their singing which continues throughout the day. At the time of writing this note, the ♂ is singing lustily on the roof of a house in front of my window. They have apparently laid their clutch in some hole in this locality though I have not been able to locate it. The birds are very shy, though the ♂ seems to be the bolder of the two. The ♀ is generally accompanied by the ♂ who shifts his perch every few minutes.
- May 16, 1931: Saw a ♂ singing from his perch on the telephone wires in front of the Municipal building. No amount of din created by the hooting and purring of passing motor cars could interfere with his song which was poured out without a break.
- May 26, 1931: Heard a ♂ singing on the outskirts of Asarva, a suburb.
- May 27, 1931: Saw a ♂ in a tree in the compound of the Mahalaxmi Training College for Females.

I have found that the song of the Magpie Robin has two distinct groups of notes. Generally it has 9 to 10 notes: 2+4+3 or 4. But the bird in front of the Municipal offices had quite different notes: *tirtu—tirtu—tirtutu* (which I confess is a poor attempt at imitation). The difference was clear and unmistakable, as I had waited for about five minutes under the bird and the song was distinctly heard. At times I have found the ♂ (watching from a roof the ♀ feeding on the ground) utter some soft whistling notes which are very pleasing though indistinct.

AHMEDABAD,

(NORTH GUJARAT.).

May 28, 1931.

HARI NARAYAN ACHARYA.

XIV.—THE MIGRATION OF THE ROSY PASTOR (*PASTOR ROSEUS* L.).

Through the kindness of Dr. J. Schenk of the Royal Hungarian Institute of Ornithology, Budapest, I have obtained a most interesting record of the recovery in India of a specimen of the Rosy Pastor which was marked as a nestling in Hungary. The particulars of this bird are as follows:

Date of Ringing: 30 June, 1925.

No. of Ring: 27381 (of the Royal Hungarian Inst. of Ornith.).

Locality: Village Novaj, N.-E. Hungary, $47^{\circ} 55'$ N. Lat. \times $20^{\circ} 30'$ E. Long.

Date of Recovery: 28 April, 1926.

Place of Recovery: Lahore (Punjab) $31^{\circ} 35'$ N. Lat. \times $74^{\circ} 20'$ E. Long.

The recovery was reported by Mr. M. J. Sheikh, proprietor of "Karachi Motor Works", Lahore, who kept the bird alive for a fortnight before it died of its wounds. Mr. Sheikh further informs me that the ringed bird was amongst a lot of twenty that fell to a single shot of his, at a place about four miles out of Lahore City. According to him the birds are plentiful in this locality between 10th April and 15th May, during which time they feed largely on "Badana" (?) berries and grow very fat, and are eagerly sought after as food. The direct air distance between the places of marking and recovery in this case is 3000 miles.

From an excellent paper on the Rosy Pastor in Uzbekistan (Turkestan) recently published in the *Journal für Ornithologie*¹ we learn that the author ringed 1,000 nestlings in 1929 and another 2000 in 1930 in that locality. The 1929 rings are 1 centimeter broad and all fastened on the right legs of the birds. They bear the inscription "UZ" in addition to the serial number. The 1930 rings belong to the Moskow Biological Station, numbers 11201-13200, and besides the serial number and the cipher F (denoting the series) they are inscribed "Moskwa-Bjun". It is very probable that some of these marked birds may be recovered in India, in which case it is requested that the person finding it, or whoever comes to hear of it, should send the information with particulars as regards number and inscription on ring, date, locality etc. to the Bombay Natural History Society who will communicate with the ringers concerned. If possible, the leg of the bird with the ring attached should also be kindly forwarded.

KIHIM,

KOLABA DISTRICT..

March 7, 1931.

SALIM A. ALI.

¹ Serebrennikov, M. K., 'Der Rosenstar (*Pastor roseus* L.), seine Lebensweise und ökonomische Bedeutung in Uzbekistan', *Jour. für Ornithologie*, lxxix, 1, pp. 29-56, Jan. 1931.

XV.—OCCURRENCE OF THE SIND RED-WINGED
BUSH-LARK (*MIRAFRA ERYTHROPTERA SINDIANUS*)
IN THE RAWALPINDI DISTRICT OF THE PUNJAB.

On the 16th October last I shot a juvenile Red-winged Bush-Lark (*M. erythroptera sindianus*) in the scrub-covered foot-hills at Kallar, some 20 miles from Rawalpindi, and in the following February obtained a pair of adults in the same locality. The specimens have been identified by Mr. H. Whistler, who informs me that this is an extension of the range of the bird which is worthy of record.

RAWALPINDI,

PUNJAB.

April 26, 1931.

H. W. WAITE,

Indian Police.

XVI.—ELEVEN KOEL EGGS IN A CROW'S NEST.

On 9th June I came upon a Common Crow's nest (*Corvus splendens*) at Bhandup (Salsette) containing eleven Koel (*Eudynamis scolopaceus*) eggs belonging to two distinct types and apparently the product of two females. There were four eggs of one type and seven of the other. I removed one egg of each type which were kindly confirmed by the Society as having been laid probably by different females. The nest contained no crow eggs, but bore obvious signs of having recently had an egg broken in it. As far as could be ascertained the locality certainly appeared to hold more koels than crows, a circumstance which may account for the concentration on this nest.

On the 17th I visited the place again to find the nest empty! There was another nest within 50 yards—not previously noticed—in which a crow was sitting.

ANDHERI,

SALSETTE.

June 20, 1931.

HUMAYUN ABDULALI.

XVII.—THE OCCURRENCE OF PIED CRESTED
CUCKOO (*CLAMATOR JACOBINUS*, BODDAERT)
IN NORTH GUJARAT.

Mr. Hugh Whistler in a recent number of the Society's *Journal* writes: The Pied Crested Cuckoo is a rainy season visitor and is spotted in Gujarat as under:

Deesa: Plenty in July.

„ : May 25 to October 20.

Anandra (Near Abu): July 5.

Rajkot (Kathiawar): June 5.

In this connexion the following observations made by me last year around Ahmedabad will be found interesting:—

June 6, 1930: Saw a pair on a Peepal tree near Ashlali, six miles south of Ahmedabad.

Nov. 6, 1930: A single bird in a Neem tree in the same locality.

Oct. 15, 1930: A young bird was observed in Bhavnagar (Kathiawar).

Between June and November, I came across the birds occasionally. They do not seem to visit this district in large numbers as the maximum I saw at any time was three.

AHMEDABAD,
(NORTH GUJARAT).

HARI NARAYAN ACHARYA.

May 23, 1931.

XVIII.—THE MIGRATION OF THE WHITE STORK (*CICONIA CICONIA*).

On the 2nd December, 1930, the leg of a stork was found in a dried up condition at the edge of a small lake in Bikanir, Rajputana and forwarded to us by Capt. Maraj Kumar Shri Sadul Singh Bahadur. The leg had a numbered ring put on through the agency of the Ornithological Station, Heligoland. The recovery was reported to Dr. R. Drost, the Director, who in reply informed us that the bird in question, a young White Stork, was ringed on the 11th June, 1930, near Braunschweig, Germany (ca 52°16' N. Lat., 10°30' E. Long).

BOMBAY NATURAL HISTORY SOCIETY,
July 15, 1931.

S. H. PRATER.
Curator.

XIX.—OCCURRENCE OF THE FALCATED TEAL (*EUNETTA FALCATA*) IN THE JHELM DISTRICT.

It may be of interest to your members to know that I shot a drake of the Falcated Teal (*Eunetta falcata*) at Chomud near Chimaainsala Battlefield, about forty miles from Jhelum in February last year. Captain Johnson of my regiment can vouch for the occurrence. The bird was in full plumage with the sickle-shaped secondaries fully developed. I intended at the time to forward the bird to you, but was unfortunately shooting for several days and on my return found that the Mess 'khansamah' had got hold of and plucked the bird in error. However, there could be no possible mistake over the identification, the specimen I shot was marked in every detail in accordance with Stuart Baker's illustration and though I had never seen the bird before, I was able to recognize it off-hand on the spot before I returned and turned up the book,...

I was so disappointed over the loss of the skin that I did not report the fact at the time and allowed it to elapse until Mr. Hopkinson recently persuaded me to do so.

If you are interested enough and would like further data, Mr. Wilson, R.E., of Roorki whom I met coming out to India this year, told me, in a chance shikar talk, that he had also shot and identified the bird on one occasion near Roorki last year.

JHELUM.
March 24, 1931.

M. C. FRYE,
Captain,
1st Bn. 1st Punjab Regiment.

XX.—THE WHITE-FRONTED GOOSE (*A. ALBIFRONS*) IN MANIPUR.

In addition to the Eastern Grey Duck reported to you in another letter, the following locally scarce birds have been shot this year:—

White-fronted Goose (*Anser albifrons*)—One shot on January 18, 1931, by Colonel M. Goodall: this is the fourth specimen recorded in the Manipur Club Game-book, which has been kept since 1910.

Eastern Solitary Snipe (*Gallinago solitaria*)—One shot by me on February 7, 1931: this is the third specimen recorded since 1910.

THE RESIDENCY,
IMPHAL, MANIPUR STATE.

J. C. HIGGINS,
I.C.S.

XXI.—ON THE DISTRIBUTION OF THE EASTERN GREY DUCK (*ANAS ZONORYNCHA*).

I was surprised to read, in Mr. Inglis' letter in Vol. xxxiv, 3 of the *Journal*, the statement that a drake of the Eastern Grey Duck (*Anas zonorhyncha*), shot in Darbhanga in March, 1929, was the first Indian record of this species excluding two specimens shot in Burma. Mr. E. C. Stuart Baker, in *Indian Ducks and their Allies*, says:—

'In 1902, Messrs. Moore and Mundy got several specimens in Dibrugarh, and each succeeding year up to 1905 got others. I obtained my first specimens in 1903, and got a good many more in 1904 and 1905.'

On the 28th December, 1908, Messrs. Botham, McKercher, Burke, Hay and I obtained 3 on a small *bhil* in the Sibsagar district.

What has always surprised me in view of these comparatively plentiful records from the Assam Valley, is the fact that this species has never been recorded from the Manipur Valley, until

recently, although the Spotbill (*Anas pæcilorhyncha*) is resident there, and is far commoner than in the Assam Valley. Between 1910 and 1931, the Manipur Club game-book records 3437 *pæcilorhyncha*. I have been present when 2265 of these were shot, and have personally examined the majority of these, as I have always been on the lookout for *zonorhyncha*. But I have only seen 2 *zonorhyncha*—one shot by Colonel Goodall on February 6th, 1930, and one by me on January 18th, 1931.

The Eastern White-eye (*Nyroca baeri*) to which Mr. Inglis also refers in his letter, is a fairly regular visitor here. It was first recorded in the Club game-book in 1912-13, since when 48 have been shot.

THE RESIDENCY,
IMPHAL, MANIPUR STATE.
March 18, 1931.

J. C. HIGGINS,
I.C.S.

XXII.—NOTES ON THE MIGRATION OF BIRDS IN THE NORTH-WEST FRONTIER PROVINCE.

The following notes on the migration of birds may be of interest to you:—

Kohat:

Demoiselle Crane. *Anthropoides virgo*. 27th August, 1928, 27th August, 1929, 25th August, 1930.

(Noted coming into India from the North-west.)

An Officer in the Mess asserted that he always hears the first *Kullam* on his birthday—27th August.

Rosy Pastor. *Pastor roseus* July 25, 1930.

The Raven. *Corvus corax* August 1, 1930.

'Teal' September 7, 1930.

In 1930 the exit of migrants from India was much delayed—Snipe and Teal were still to be found in the Kohat District as late as 1st. May. It was an exceptional year so much so that flowers normally coming out in September bloomed in April and the Chrysanthemums came into bud and flowered here then, their normal season being November to December.

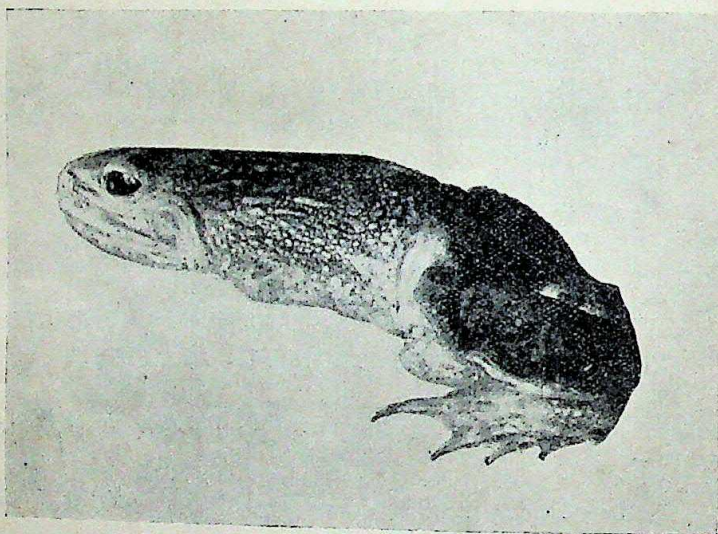
KOHAT,
N.-W.F.P.
7-12-1930.

G. de la P. BERESFORD,
Lt.-Colonel, M.C.

XXIII.—CONGENITAL ABSENCE OF A FORE-LIMB
IN A BULL FROG (*RANA TIGRINA*).

(With two photos.)

During the monsoon of 1930 a collection of frogs and toads from Thana was made by the Pharmacological Department of the G. S. Medical College, Bombay. One of the specimens showed the absence of a left fore-limb. Later on the specimen was transferred to the Embryology Department of the same College.

FIG. A. *Rana tigrina* lateral view.

The sitting posture of the animal was very queer (Fig. A.). The surface where there was the absence of the arm presented no mark of any kind, and the skin, colour, and the contour of that region was just like that of the surroundings (Figs. A. and B.). Fig. A. shows the dorsal view of the specimen and Fig. B. the left lateral view of the same.

The absence of the limb does not seem to have affected in any way the normal development of the frog, and obviously it could get its food without much difficulty.

On dissection, the following peculiarities were noticed. The pectoral girdle of the right side was fully developed while the supra-scapula alone represented the pectoral girdle of the left side; the scapula, the coracoid, and the clavicle being completely absent.

Instead the pectoral muscles were greatly developed and they took their origin from epicoracoid region and were inserted into the inner concavity of the supra-scapula.

In the arterial system, the subclavian or branchial artery was found to be absent.

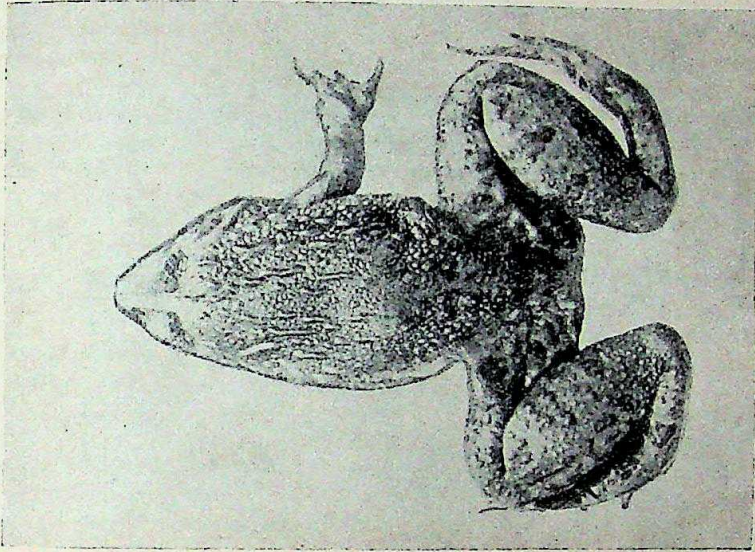


FIG. B. *Rana tigrina* dorsal view.

The subscapular from the back of the arm and the branchial from the arm of the left side were absent.

All the nerves which in ordinary condition used to arise from the brachial plexus were found to be in a rudimentary condition on the left side while, on the right side, all the nerves were found to be normally developed.

DEPARTMENT OF EMBRYOLOGY,
GOCULDAS SOONDERDAS COLLEGE,
BOMBAY.

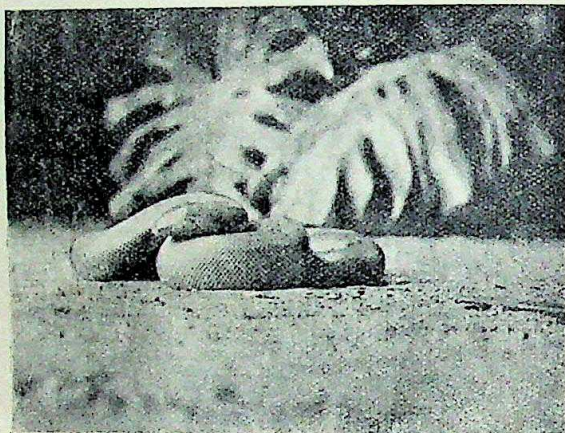
G. M. KURULKAR,
D. S. DESHPANDE.

XXIV.—THE COLOURATION OF THE TAIL OF THE COMMON SKINK (*LYGOSOMA PUNCTATUM*.)

(With a photograph.)

A friend of mine recently asked me why the tail of the common skink of these parts (*Lygosoma punctatum*) is red, while the rest of the body is brown or olive above. The cause, of such peculiar coloration, though not mentioned so far, is not hard to seek. The tail of the skink, like that of the house-lizard (*Hemi-*

ductylus flavivirides), is fragile and serves as a device for defence. When the creature is attacked, the tail breaks away from the body and begins to perform a series of convulsive movements, jumping and twisting as if in great pain and thereby diverting the enemy's attention from the escaping tail-less trickster. The red color makes the tail prominent and increases its efficiency.



The Sand Boa (*Eryx johnii*).
(Note the head-like tail).

Nor is it only in the skinks and the house-lizards that the tail has taken on itself the task of deceiving the attacker. Amongst others, the case of the common Sand Boa of Agra (*Eryx johnii*) might be mentioned. Here the stumpy, bluntly-rounded tail looks so much like the head that the snake has been given the name 'Dumuli' (the 'two-headed' in Hindustani). The snake-charmers of India have spread a great many lies on this point, and there are people who believe that this Sand Boa, after using one end of its body as the head for six months, gives that honor to the other end and drags the former head behind it as the tail. Really the tail of the sand snake is a tricky device for defence. When attacked, the sand snake tries at first to escape, but if it finds such efforts futile, it coils itself tightly, keeping the head below the coils, and making the tail jut out at some prominent point (see photograph). The tail by its appearance diverts attention from the actual head.

ST. JOHN'S COLLEGE,
AGRA.

BENI CHARAN MAHENDRA,
Lecturer in Zoology.

March 30, 1931.

[The red colouring of the end of the tail may in some skinks be a condition dependent on age. The young of the common skink (*Mabuia carinata*) frequently have the extremities of the tails coloured red, this disappears with age. The same character is displayed by the American Blue-tailed skink. In the young the tail is bright blue; as the skink grows older the colour fades to grey. In the skink referred to in the above note the red persists throughout life. Mr. Mahendra's interpretation of the red colouring of its tail as a defensive adaptation provides an interesting contrast to the theory which explains the red end of the tail of certain Vipers as a medium of offence. Young examples of the Green Pit Viper (*T. gramineus*) and of the Large-scaled Viper (*T. macrolepis*), uniformly green snakes, often have the ends of their tails coloured red. It is suggested that the dash of brilliant colour attracts small birds, lizards and frogs. Coiled among vegetation the green coloured owner of the red-tipped tail is practically invisible.

The tail of the Sand Boa (*Eryx johnii*) is again believed to be useful to the reptile in overcoming its prey. In our desert regions, where this snake is common, it is generally seen half buried in the sand with its stump-like tail projecting like some forlorn root. A gerbille or field mouse brushes against or inspects the stump. The snake is galvanised into activity, leaping from the sand it flings its coils about the rodent and holds it in a vice-like grip. Eds.].

XXV.—NUMBER OF VENTRAL SCALES IN THE FASCIOLATED DHAMAN (*Z. FASCIOLATUS*).

Boulenger in an old edition of *Reptilia of India* states that *Zamenis fasciolatus* has 197-225 ventrals, 73-88 subcaudals. He does not mention the Bombay Presidency as a habitat for the snakes recorded by him. Wall mentions:—ventrals, 191-232, subcaudals, 73-92. The four specimens secured by me, three from Ahmednagar and one from Vizapur have;—

- (1) Ventrals 228, subcaudals 61. Length of snake 4ft. 8 ins.

A note was published in your journal about this specimen.

- (2) Ventrals 232, subcaudals 37. Length of snake 4 ft. 6 ins.
- (3) Ventrals 240, subcaudals 87. Length of snake about 18 ins.

This specimen was sent to me from Vizapur.

- (4) Ventrals 232, subcaudals 50. This specimen was sent to you lately.

So it seems that the range of ventrals will have to be increased to 240 and of the subcaudals lowered to 37 unless this type is considered a variety.

AHMEDNAGAR.

26-6-1931.

15

K. G. GHARPUREY,

Lt.-Colonel, I.M.S.

XXVI.—DETERMINING THE AGE OF INDIAN FISHES
FROM THEIR SCALES.

The methods for determining the age and the rate of growth of fish by an examination of scales, otoliths etc. have not so far been attempted in India, neither have the scales of Indian fish ever been subjected to a critical examination. As the result of an extended observation of fish scales from different parts of India, I have come to the conclusion that the scales from Indian fish no doubt present very great difficulties inasmuch as the rings on these are not well marked. This feature introduces peculiar difficulties which greatly handicap their elucidation. I have, however, come across some scales on which by the graphical method evolved by Winge, one could pick out what would appear to be distinct growth rings but one should hesitate a good deal before accepting them as age rings.

In India as elsewhere each species of fish must be investigated by the methods which one can best apply to it. What holds good in one species is not necessarily applicable to another, and apart from this even a specialist on scales from English fish would not venture to pronounce any definite opinion with regard to the interpretation of Indian scales. Even when one has specialised in reading the scales of one species of fish, it does not follow that he is quite qualified for applying the same principles to other species, as for instance a Salmon scale specialist in England is not the most competent person to advance an opinion on Trout scales.

To be able to say anything definite, one must examine as many fish of one species as possible in detail, carry out systematic measurements of rings to discover their interpretation. I feel we have ample material for age and growth studies of fish in India.

ROYAL INSTITUTE OF SCIENCE,
BOMBAY.

June 10, 1931.

S. B. SETNA,
M.Sc. Ph.D.

XXVII.—NOTES ON THE BEETLE
PLATYPRIA ECHIDNA, GUER.

On the 10th of May I found a large number of these beetles congregated under the leaves of *Zizyphus rugosa*, Lamk. at Khanda. On examination of the leaves, it was discovered that the beetles were feeding on the epidermis of the upper side. So far as I am aware this plant is not known to constitute the food of these insects. *Platypria erinaceus*, F. is said to have been found on a species of *Zizyphus* at Belgaum. *Platypria andrewesi*, Ws. was taken on *Zizyphus jujuba*, at Nagpur and on a species of *Zizyphus* at Hajari. It was also obtained on sugar-cane leaves. *P. hystrix*, F. was taken on *Erythrina indica* at Madulsima, Ceylon. Thus we see that the majority of the genus, so far as is known, have been taken largely on species of *Zizyphus*.

When touched these beetles dropped vertically to the ground (as is the habit of many insects) and tried to hide themselves in the fallen leaves. Some of them took to flight when they reached the ground.

On the 29th May I came across many more specimens of the same species (*P. echidna*) on the same food plant (*Z. rugosa*). At this period I also found a few in copulation.

BOMBAY NATURAL HISTORY SOCIETY,
6 APOLLO STREET, BOMBAY.

C. McCANN, F.L.S.,
Asst. Curator.

XXVIII.—ON THE FERTILIZATION OF THE FLOWERS OF THE SAUSAGE TREE (*KIGELIA PINNATA*, DC.) BY BATS.

(With 3 diagrams.)

My observations on the opening time of the flowers of the Sausage Tree (*Kigelia pinnata*, DC.) soon brought me to the conclusion that the flowers are nocturnal. They open in the evening usually between 5-30 and sunset and by about 9 a.m. the next morning, provided the flowers have been fertilized, all the corollas drop to the ground leaving only the calyx and style in position. When fertilization has not been effected the entire flower falls away from the articulation immediately below the calyx. The corollas—deep blood- or wine-red within, and yellowish-green on the outside—are large and fleshy with many wrinkles and furrows. When open, the flowers emit a strong and somewhat unpleasant odour. The four stamens are placed in the manner characteristic of the order *Bignoniaceæ*, to which this species belongs. The bases

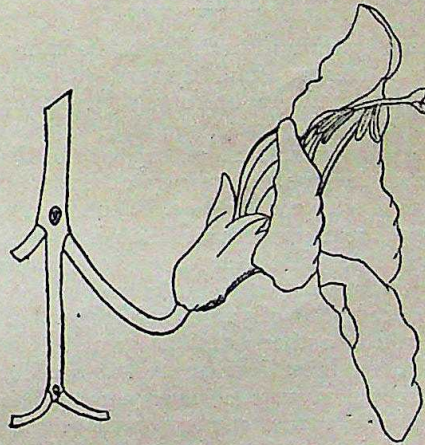


FIG. 1. Position of flower of *Kigelia pinnata*.
(Half nat. size).

of the filaments are much thickened and are densely papillose within the throat of the flower; together with the style, these swollen bases fill up the entrance to the throat. The style is long, tapering from the base upwards; it is somewhat recurved and exerted beyond the corolla. The stigma is bifid and appears like two leaf-like structures at the extremity of the style. At the base of the ovary are situated several large nectar glands which secrete a copious

amount of clear sweetish nectar. This liquid fills up the cavity between the nectaries and the throat of the flower and trickles out into the furrows of the lower petal when the flower is bent downwards.

It appears curious that such a deep-red coloured flower should be adapted for nocturnal fertilization. In passing, it might be mentioned however, that similarly dark-coloured flowers also noc-

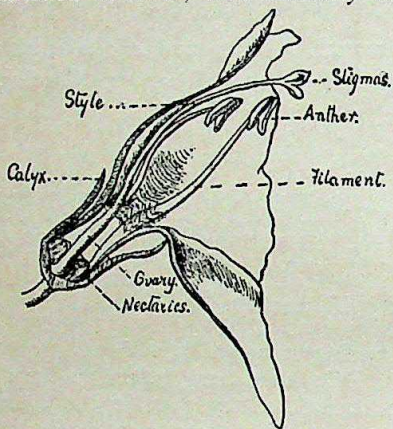


FIG. 2. Longitudinal section of the flower of *Kigelia pinnata*. (Half nat. size).

turnal in habit has been observed by me in the case of *Oroxylum indicum*, Vent. a common species on the island of Salsette, and belonging to the same natural order. In this case also I find that the flowers only open in the evening and are shed by the next morning, making it next to impossible to obtain a photograph of the tree in flower without the aid of a flashlight. On the other hand, I consider it noteworthy that *Heterophragma Roxburghii*. DC. and *Stereospermum xylocarpum*, Wight, also belonging to the same order and both fairly common in the same locality (Salsette) have creamy-white flowers ("night-coloured") which open only during the daylight hours! It was not until I accidentally observed a bat visiting one of the *Kigelia* flowers that I was led to investigate the matter further. Many of the *Bignoniaceæ* are said to be fertilized through the agency of birds, though in the case of a species like *Oroxylum indicum*, Vent. this process appears to me hardly applicable since most birds are already on their way to roost by the time the flowers open. An examination of the *Kigelia* flowers which opened early in the evening showed that the anthers were not yet ready to disperse their pollen, whereas those examined at dusk had the anthers perfectly ripe and the pollen ready for dispersal. The slightest jerk to the flower caused the pollen to drop down directly on to the lower petal. The fact, therefore, of the pollen only becoming ready for dispersal at dusk does away with the possibility of fertilization by birds, at least the diurnal ones.

The nectar is produced in such large quantities that one literally gets a shower bath when plucking an inflorescence since, as has already been mentioned, it trickles freely into the furrows of the lower petal when the flower is bent down.

There are two avenues planted entirely with *Kigelia pinnata* trees not far from where I reside, in Gell Street and Club Back Road (Agripada). In the flowering season, March-July¹ I frequently visit-

¹ I have seen flowers and buds on certain trees as late as the end of August and early September.

ed these roadside trees at different times of the day and night to study more about the fertilization of their flowers. I noticed that at dusk the avenues were regularly visited by numbers of the Short-nosed Fruit Bat (*Cynopterus sphinx*) and was not a little surprised to discover that these animals were really responsible for the fertilization of the flowers. On several occasions I observed the bats visiting the open flowers, thrusting their heads into them and after hanging there a short while, flying off again. The bats are no doubt apprised of the open flowers by the strong smell they emit, as they were seen to circle round and round the trees before alighting. When the bat alights, the flower stalk, which is sharply bent upwards in its upper quarter, is deflexed by the weight of the

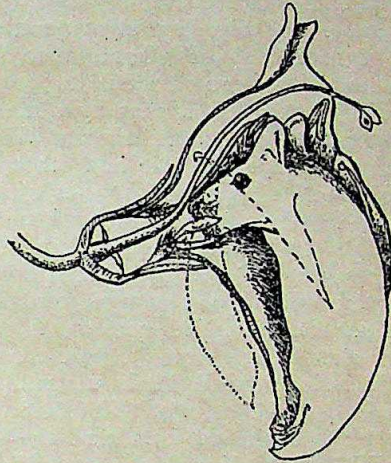


FIG. 3. Position of bat in flower.
(Drawn from memory).

animal and at the same time the peduncle of the flower swings, causing the nectar to ooze out on to the petal from where it is greedily licked up by the bat. In all probability at the time of the bat's impact with the flower the ripe pollen is shed on to the head of the bat as it is being inserted within, though there is also another possibility in that the head or ears of the visitor may actually come in contact with the anthers. There is yet the further possibility that as the bat throws its head back when taking to flight (as is its habit) the snout may come in contact with the anthers. Whatever be the exact manner in which the pollen is transferred to the fur, I think there is good ground for assuming that the head or snout of the bat or both, does get covered with pollen. When the bat's head is inside the flower the stigmas protrude over and directly behind it and in a position where the pollen-besmeared snout or crown must unavoidably brush past them when the animal takes to wing again, thus effecting pollenization. Assuming that the bat has been visiting other flowers previously and that its head has become covered with the pollen from these, there are two possible ways in which it may be transferred to the stigmas: (a) while entering the flower the head may come in contact with the stigmas, or (b) the impact and weight of the alighting bat which causes the flower to sway violently up and down may bring the stigmas into contact with the bat's head. Both these possibilities may indeed even operate simultaneously, but there seems to me no doubt that this bat is in a large measure responsible for the fertilization of the flowers of this tree. I realize that for conclusive

evidence it would be necessary to shoot the visiting bats for examination, but unfortunately in the present case I am unable to do so owing to the proximity of dwelling houses and the Police Regulations.

My thanks are due to my friend Mr. Salim Ali for reading over this note and drawing my attention to two important papers by Dr. Otto Porsch of Vienna¹ who has in recent years made some most valuable contributions to our knowledge on the subject of the fertilization of flowers by birds and mammals.

According to Porsch, Hubert Winkler was the first to point out from the shape and size and other peculiarities of the flowers of a closely related species, *Kigelia africana*, Benth. that this may be of bat-fertilized species although he was unable to record the visits of bats by direct observation. Porsch's own observations on *K. pinnata*, DC., in the Buitenzorg Gardens, Java, convinced him that the flowers of this tree were fertilized by bats. In regard to another closely allied species, *Kigelia aethiopica*, Decne., Porsch was also struck by the nocturnal habit of the flowers, their characteristic smell, their unusual colours and the width of the opening of the corolla. The fallen flowers under the tree showed the tooth-marks of bats and the fact that the flowers could be available to birds only for a very short time in the early morning hours, precluded the possibility of their (birds) being important pollinating agents.

Heide, who also made observations on *K. aethiopica* in the Dutch East Indies, was of opinion that the bat *Eonycteris spelaea* Dobs. which was the pollinating agent he observed, was attracted to the flowers solely by the pollen which it gathered from the anthers by means of its specially adapted rasp-like tongue. On the tongue and snout as well as inside the stomach and intestines of a specimen he shot, were found only pollen without any traces of petals or other parts of the flowers. He makes no mention whatsoever of nectar being sought, but as Porsch points out, if pollen was the bat's sole quest it is unintelligible why the visitor should thrust its head so deep down into the flowers, as has also been observed by me, and he himself is inclined to the belief that nectar is the bat's main objective.

L. V. D. Pijil, without being aware of Heide's work has independently corroborated the latter's observations in regard to the visits of bats to the flowers of *K. aethiopica*. This observer also refers to the nocturnal habit of the flowers and to their characteristic smell, but according to him likewise the chief object of the bats' visits is the pollen though he admits that at the same time nectar may be eaten.

Spennemann has observed that carrion-smelling flowers of *Oroxylum indicum* (L.) Vent. to be visited and fertilized by bats, and my note helps to confirm his remark that the flowers open in the

¹ Porsch, Otto. 'Blütenstände als Vogelblumen', Österreichische botanische Zeitschrift, 1923, Nr. 6-8, pp. 125-149.

² Porsch, Otto. 'Crescentia—eine Fledermausblume', Öst. bot. Zeitschrift, Heft 1, Jahrg. 80, pp. 31-44.

evening and drop off the next morning. Finally Forsch has recently described from Costa Rica the flowers of *Crescentia cujete*, L. and *Crescentia alata*, H.B.K. (Order *Bignoniaceæ*) to be visited by bats, and by a careful study of their structure and physiological peculiarities he arrives at the conclusion that they are undoubted bat-flowers. Already in 1922 his investigations in tropical countries had convinced him of the existence of purely bat-fertilized flowers.

This opens up a vast field for observations in India, and I hope my note will induce other observers to take up the study of bat-fertilized flowers.

BOMBAY NATURAL HISTORY SOCIETY,
6 APOLLO STREET,
BOMBAY.
23-7-1931.

C. McCANN,
F.L.S.,
Assistant Curator.

XXIX.—OCCURRENCE OF *ISOËTES* IN THE BOMBAY PRESIDENCY.

Roxburgh in his *Flora Indica*, Vol. III, page 745, (1832), records two species of *Isoëtes* from India, viz. *I. capsularis*, Roxb. and *I. coromandeliana*, Linn. But so far as our knowledge goes none have been reported from the Bombay Presidency. On the 3rd September I discovered a species of this genus in rocky pools at Khandala (W. Ghats). This specimen is different from those described in the *Flora Indica* and is in all probability a new species. In a subsequent issue of the *Journal* I hope to be able to publish the full description of the plant. This constitutes the first record of the *Isoëtaceæ* in the Presidency.

BOMBAY NATURAL HISTORY SOCIETY,
BOMBAY.
September 15, 1931.

C. McCANN,
F.L.S.,
Assistant Curator.

PROCEEDINGS OF THE MEETING OF THE BOMBAY NATURAL HISTORY SOCIETY.

A meeting of members of the Bombay Natural History Society and their friends was held at the Prince of Wales' Museum on Wednesday, the 15th July 1931, at 6 p.m. Col. Sir Frank Connor, D.S.O., I.M.S., presiding.

The Honorary Secretary Mr. P. M. D. Sanderson announced the election of the following 14 new members since the last meeting held on 30th March 1931:—

The President, Mess Committee, 1st North Staffordshire Regiment, Nasirabad; Dr. V. R. Khanolkar, B.Sc., M.D., Bombay; The Conservator of Forests, Cochin State, South India; Mr. W. J. L. Smith, Palaw, Burma; Mrs. A. J. Wadia, Bombay; The Mess President, 2nd Lancers, Meerut; Mr. F. J. Guthrie-Smith, I.C.S., Meerut; The Director, Transvaal Museum, Pretoria; Captain D. L. Duncan, Loralai, Baluchistan; Mr. L. E. Hunt, Calcutta; Mr. Framji Dessabhoy Wadia, Poona; Lt. R. F. H. Drake-Brockman, B.A., Bangalore; Captain G. W. McCarthy, Agra; His Highness Maharaja Shri Himmat Singhji Saheb Bahadur, Idar State (Life Member).

Mr. P. M. D. Sanderson referred to the recent publication by the Society of Captain Bates' book on *Bird Life in India*. The author is well known to readers of the Society's Journal. His illustrated articles on Indian Birds and their Nests have formed an attractive feature of its pages. To his ability with the camera Captain Bates adds the gift of close and patient observation. His notes and pictures of Indian Bird Life make up a charming and readable book, which will appeal to all who are familiar or wish to be familiar with the birds of this country.

The Honorary Secretary announced the forthcoming publication of a second edition of Brigadier Evans' *Identification of Indian Butterflies*. The first edition, which was issued 3 years ago, sold out very quickly. Since then there have been frequent enquiries for the book which, with its hundreds of illustrations of Indian Butterflies and its simple keys, is an invaluable guide to collectors and to people interested in this subject. The second edition has been revised and enlarged should have as ready a demand as the author's previous book.

BIRD COLLECTING IN THE HIGH ALTITUDES OF SIKKIM.

In the spring of this year the Society co-operated with the Field Museum of Chicago and the British Museum in a collecting expedition in Sikkim. Mr. V. S. LaPersonne, Assistant Curator, was sent to help Mr. Stevens, the leader of the expedition in this work. Mr. Stevens was compelled to return to England shortly after LaPersonne joined him and Mr. LaPersonne continued alone. A base camp was established at 16,000 ft. in Northern Sikkim and

from this point excursions were made to 19,000 ft. on to the highlands of Tibet. Mr. LaPersonne has brought back a remarkable collection from this cold, bleak region and from the dense tropical forests of the lower altitudes of the Eastern Himalayas. Some of the specimens obtained were on view to members. They included two species of Marmots, the Tibetan Hare and examples of such birds as Grandalas, Choughs, Snow Pigeons and Accentors which live in these high altitudes. Among the exhibits were four magnificent wild dogs shot at an altitude of 10,000 ft. where they prey mainly on sheep and ponies.

A NEW EXHIBIT AT THE MUSEUM.

Mr. S. H. Prater, the Society's Curator, invited the members and their friends to a private view of the new group in the Mammal Gallery of the Museum and which will be shortly opened to the public. The group is a representation of a pair of tigers drinking at a forest stream. The scene is laid in the dense rain-swept forests of the Naga Hills in Assam, where the material and accessories of the group were collected during an expedition undertaken in conjunction with the American Museum of Natural History, New York, last year. The background depicting the dense forest, painted from studies made in the field by Mr. K. B. Sawardekar, the canopy of feathery bamboos, the moss covered boulders of the stream, the beautiful lighting effect provide a magnificent and realistic setting for the tigers. These were mounted by Mr. C. McCann and represent fine examples of the high development of modern taxidermy. The group makes a wonderful addition to the Museum and is one of which the people of this city may well be proud.

PERSIAN, AFRICAN AND INDIAN LIONS IN THE FIRST CENTURY.

Dr. Sir Jivanji Modi then read his interesting paper on Indian, Persian and African Lions in the First Century. The following is a brief outline of Sir Jivanji's notes:—

The subject of the paper is suggested by an interesting paper on 'The Lions of Asia' by Mr. R. I. Pocock, in a recent issue of the *Journal of the Natural History Society*. The present paper was divided into two parts. (1) The Lions from an old Iranian point of view. (2) Appolonius of Tyana, a Greek ascetic, on the Lions of Persia, Africa and India.

Lions do not seem to have flourished towards Bacteria (Balkh) where the Parsi Avesta Scriptures were written, but they flourished in the Western part of the Iranian Empire where some Pahlavi literature was written. The Pahlavi books agree with Mr. Pocock in associating the Lions, Panthers and Tigers in one genus, the genus of 'the Great Cats'. The Iranian word for Lion viz. 'Shir' seems to come from khshathra 'King'. A Lion is the King of the Animal world.

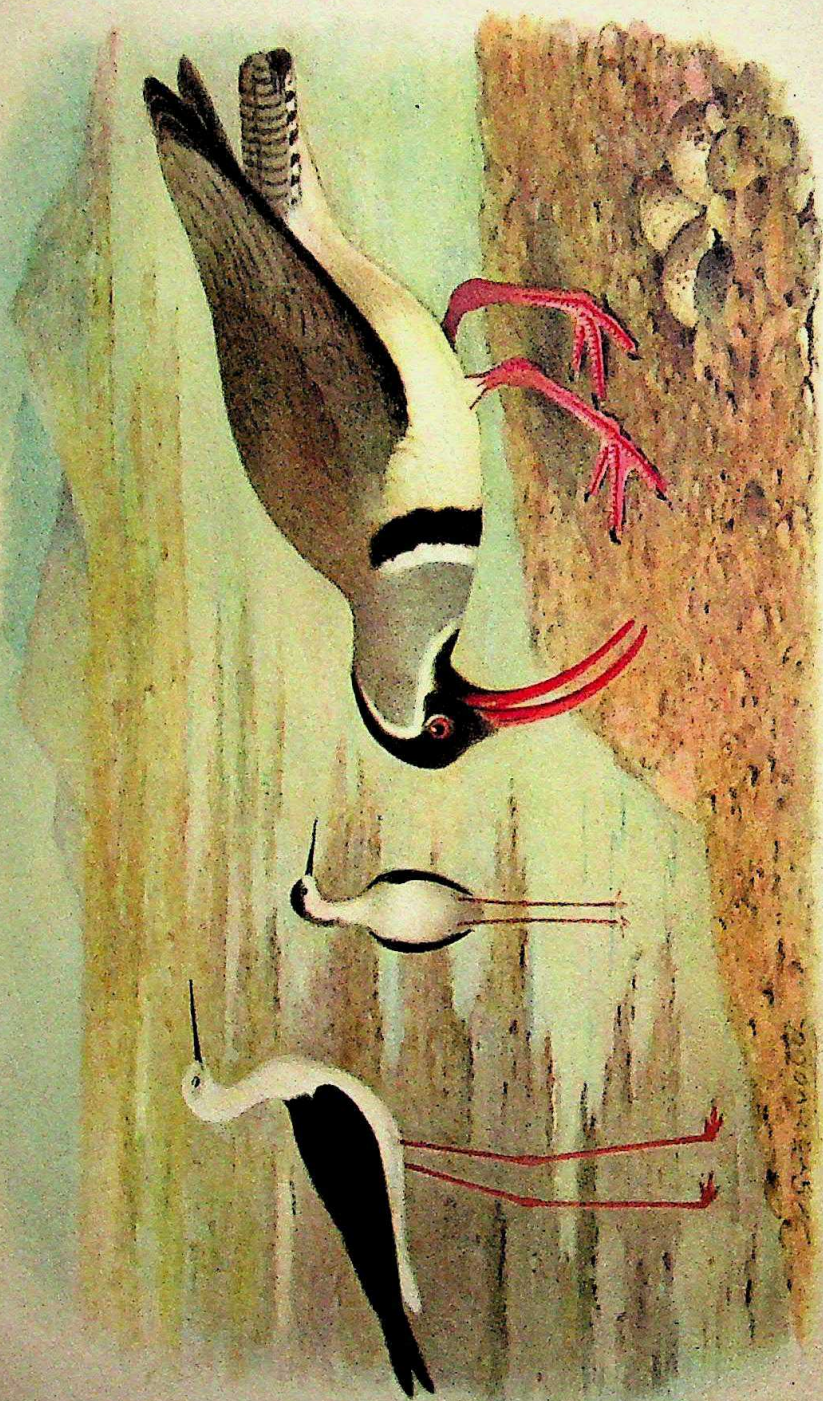
Appolonius of Tyana, a Greek ascetic of the Indian *Sadhu* type, who abstained from animal food, wine and women and who observed total silence occasionally for days together, and believed in

metempsychosis had travelled a good deal in the Iran of Parsi Mobeds and India of Hindu Brahmins; and in the account of his travels we find an interesting account of the Lions of Persia, Africa and India. In that account we find the following particulars:—

- (a) The normal period of gestation is six months.
- (b) Each lioness had only three litters in her life, having 3 cubs in the first litter, 2 in the second, and 1 in the third.
- Appolonius saw an extraordinary lioness with 8 cubs.
- (c) They took predictions from lions.
- (d) The Iranian Kings had their preserves of lions at Babylon, where they hunted with beaters.
- (e) The souls of kings e.g. King Amasis of Egypt, metamorphosed into lions who were royal beasts.
- (f) In one part of India, the apes helped men in collecting pepper from mountain cliffs. There men killed lions in great numbers because these lions killed the apes who helped them.
- (g) Lionesses in some parts of India mated with tigers and gave birth to spotted cubs which the lions killed at first sight taking them to be 'bastards'.
- (h) Indians ate the flesh of lions.

The full text of the Paper will be published in the next issue of the *Journal*.

An interesting discussion arose from Sir Jivanji's reference to apes (described as being black in colour) helping men in collecting pepper from the mountain cliffs. It was suggested by Mr. Prater that the statement may throw some light on the more southerly range of the lion in India than now recorded. Pepper is confined to the South-Indian Forests, where also live two species of monkeys, which are uniformly black in colouring and answer to the description of the writer. It is a fact that the aboriginal hill-tribe of Mysore—the Sholagas—have a name for the Lion. They call it "Simba" which curiously enough is the Swahili name for the lion.



THE BLACK-WINGED STILT. $\frac{1}{2}$
Himantopus h. himantopus
 Male adult, juv.

THE IBIS-BILL. $\frac{1}{3}$
Ibidorhyncha struthersii.

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VOL. XXXV

No. 3

THE GAME BIRDS OF THE INDIAN EMPIRE.

BY

E. C. STUART BAKER, C.I.E., F.Z.S., F.L.S., M.B.O.U., H.F.A.O.U.

VOL. V.

THE WADERS AND OTHER SEMI-SPORTING BIRDS.

PART XVI.

(With a coloured plate).

GENUS : HIMANTOPUS.

Himantopus Brisson, Ornith., i, p. 46 ; v, p. 33 (1760).

Type by taut., *Charadrius himantopus* Linn.

In this genus the most remarkable character is the great length of the legs, the tibia being very long, as well as the tarsus, and bare over about three-quarters of its length; the tarsi are reticulated throughout; there is no hind toe and the outer toe is joined to the middle toe by a broad web, that between the inner toe and middle toe being narrower; the bill is long, straight and slender, the dertrum not swollen; the nostrils are long slits placed in the base of a groove which runs about half the length of the upper mandible; the wing is long and pointed, with the first primary longest; the tail is short and even.

Stilts are resident birds in nearly all tropical and temperate countries; one species of very wide range occurring in India.

HIMANTOPUS HIMANTOPUS HIMANTOPUS.

The Black-winged Stilt.

Charadrius himantopus Linn., Syst. Nat., 10th. ed., i, p. 151 (1758) (Southern Europe); Stuart Baker, Fauna B. I., Birds, vi, p. 193, 1929.

Vernacular Names.—*Gaj-paun*, *Tinghur* (Hind.); *Lal-Gon*, *Lal-thengi*, *Lam-gora* (Beng.); *Gusling* (Sind).

Description : Adult Male.—Mantle and wings, above and below, black, glossed with metallic green; upper tail-coverts tinged with

brownish-grey; tail delicate, pale, grey-brown; remainder of plumage white, a few black spots often showing on the head.

Colours of soft parts.—Iris bright red; bill black; legs and feet crimson-red, the claws black.

Measurements.—♂ Wing 240 to 253 mm.; tail 80 to 86 mm.; tarsus about 115 to 145 mm.; culmen 60 to 69 mm.

♀ Wing, 227 to 236 mm.; culmen 54 to 68 mm.

Females have the back, scapulars and inner secondaries brown instead of black; the white head is nearly always sullied with some grey, whilst the hind-neck also often shows some grey.

Young males have the anterior crown, upper ear-coverts and a line down the back of the neck black.

Nestling.—Upper plumage pale fulvous, mottled with black, this forming very indefinite lateral and a distinct median coronal line; there is a fairly distinct dorsal line with an arrow-head cross-line on the shoulders and extreme rump.

Distribution.—Southern Europe, Africa, Central and Southern Asia to Ceylon, Malay Straits, etc. In India, the Stilt is very generally distributed wherever there is suitable country near, but on the other hand there are wide areas where I think it never occurs at all or merely as a wanderer during the cold weather.

Nidification.—The Stilt is a resident bird breeding wherever it is found, provided there are suitable places. It makes its nest in swamps and marshes, sometimes actually in the shallow water, sometimes on little islands or on the edges of the swamps. Its time of breeding is governed to a great extent by the question of water-supply, though the majority of birds seem to nest during April and May, before the rains break, when there is a vast extent of shallow muddy water with an ample supply of food. In former days they used to breed in vast numbers on the Sultanpore salt works, about 35 miles south of Delhi. The birds were present round about these works throughout the year, but about the middle of April they began to congregate in great numbers. The salt works consisted, according to Hume, 'of brine wells and many hundred acres of shallow, rectangular, evaporating pans from 100 to 200 feet square and from 6 to 10 inches deep. These pans were merely depressions dug in the soil and lined with *chunam* or fine lime obtained by burning *kunker*, a nodular concretionary limestone found in beds near the surface more or less throughout the plains of Upper India. Small strips of ground from a foot to five or six feet broad divide the pans, where only a little brine ever stands. On these the Stilts build their nests.'

'They collect together small pieces of *kunker*, or the broken lime-lining of the pans, into a circular platform from seven to even twelve inches in diameter and from two to three inches in height; on this, again, they place a little dry grass, on which they usually lay four eggs, but, not infrequently, only two or three. They begin to lay, according to season, towards the end of April or the beginning of May; and by the beginning of June, numbers of young are to be seen about, and by the 1st July most of the eggs that remain are hard-set. The majority of the birds lay during June, earlier or later according to season.'

'The temperature of the nest at this time in the full sun probably averages quite 140° Fahrenheit.'

Doig records it as nesting in a somewhat similar situation in the Eastern Narra in June, where they make their nests on the salt-encrusted ground. They also breed in the marshes of Sind, but here they are sometimes driven away by the drought which completely dries up all water of their breeding places. Even then, however, a few pairs will sometimes stay, as Ticehurst records three pairs of Stilts breeding on the Khinjur Lake at Jhimpir reduced by the drought to a sheet of water less than half a mile around. The nest varies considerably in construction. Those laid on dry ground, such as the salt pans, consist of little platforms of broken limestone or *kunker*, varying from seven to twelve inches in diameter and from two to three inches in height. Sometimes these are lined with a little grass, sometimes they are quite unlined. At other times the nest is a mere platform of earth, or just a hole is scraped in the ground and lined with small stones or similar material. When made in muddy soil or actually in the water, the nest is often of considerable size consisting of a pile of water-weeds, stones and other rubbish, sometimes as much as a foot in height and comparatively broad. On the top of this pile a small depression is made with a little dry lining on which the eggs are deposited. Sometimes the nests are scattered about over a considerable area but at other times they are made close together; thus Hume records finding 38 nests on a strip of high dry ground three feet wide and a hundred feet long, in addition to which there were five nests of the Red-wattled Lapwing.

In Mesopotamia, where Pitman found them breeding in vast numbers on the Musseyib marsh, Euphrates Valley, the nests were often so close together, that the sitting birds almost touched one another; here the nests were nearly all on little islands, but even in such places the nests were bulky affairs, whilst some of those built in the shallow water were over two feet in height. In Ceylon, these birds seem to have two breeding seasons: the first, from early March to May, and the second, in the North, during July and August. There the birds breed both in marshes and on the great inland lakes, where they generally make use of small islands. The number of eggs laid seems to be either four or three, though a great many birds only lay two eggs, whilst five have been found in the same nest once or twice. In appearance the eggs are distinctly like those of the plover's but decidedly less pyriform than most. The colour varies very little, nine eggs out of every ten having a ground colour of greenish brown or light brown marked with spots, specks and blotches, or occasionally streaks of black, blackish brown or rich umber brown. Secondary markings very seldom occur, and when they do, they are of a rather dark inky grey. The markings are distributed fairly numerously over the whole surface but generally more numerously at the larger end, and nowhere thickly enough to obscure the ground colour. In a few eggs the tint may be anything varying from a pale yellow or yellow-grey stone colour to a warm tint of the same, but such eggs are exceptional.

In shape the eggs are rather long and pyriform with a smooth and often a silky texture. Jourdain gives the average of 100 European

eggs as 44.0 by 31.0 mm. Eggs taken in Mesopotamia average rather larger; forty-two averaging 45.1 by 30.7 mm. with a maximum of 48.2 by 33.0 mm., the smallest being 38.0 by 28.0 mm. A hundred Indian eggs on the other hand average almost exactly the same as the English eggs, that is to say, 43.8 by 30.8 mm.

In Ceylon, Waite found them breeding in small grassy islets in the salt lakes, where they made no nests beyond a thin lining of reeds to a shallow scratching in the ground. In Southern Burma, where they have also been found breeding, the nests were described as comparatively thick masses of muddy weeds lined with a few dry ones.

The birds are very clamorous round their breeding grounds, circling over an intruder's head, uttering loud cries the whole time. They are not shy birds when nesting and, generally, allow a fairly close approach to the nest before taking their departure whilst, in the days when they bred in the salt works, they got so used to human beings passing backwards and forwards that they would continue to sit on their nests even when the workers came within a few inches of them.

One would have imagined that to birds with such immensely long legs, sitting on their nests would be a matter of no little difficulty but, as a matter of fact, they seem to tuck them up under themselves just as comfortably as the short-legged birds can.

Habits.—This is a resident bird though it may be forced to make local migrations in times of drought or in the wetter parts when there are heavy floods. It is always a gregarious bird and it will nearly always be found in small parties though occasionally single birds and pairs wander away some distance in search of food. In the breeding season the smaller parties collect in still bigger flocks and, as has already been remarked, some of their breeding colonies number many hundreds. On the wing the Stilt has an easy, rather flapping flight, though it is capable of moving at a considerable pace when frightened. Its slight form, with the long thin legs trailing behind, give it a rather curious appearance, recognizable at a great distance. When feeding, it usually walks slowly and quietly about in the shallow water, though it can run at some speed and it also swims well. Its food consists principally of aquatic and other insects, fish-fry, frog-spawn and tadpoles, small frogs, lizards, etc., as well as small mollusca.

GENUS: RECURVIROSTRA.

Recurvirostra Linn., Syst. Nat., 10th ed., i, p. 151 (1758).

Type by mon., *Recurvirostra avocetta* Linn.

In this genus the bill is very long, flexible, curved upwards towards the tip, depressed and with both mandibles flattened; the nostrils are placed near the base in an ill-defined groove, which extends over less than half the upper mandible; the tarsi and tibia are long and bare, the former reticulated; there is a small hind toe and claw and the anterior toes are deeply webbed, the webs notched in the middle; the wing is long, the first primary longest.

As in the preceding genus, *Himantopus*, the value of the differences in these birds has been considered from various points of view by

different systematists, some considering them merely of subspecific value, whilst others consider them to be not only specific but generic. One species, the type of the genus, occurs in India.

RECURVIROSTRA AVOCETTA AVOCETTA.

The Avocet.

Recurvirostra avocetta Linn., Syst. Nat., 10th ed., i, p. 151 (1758) (Europe, Oland); Stuart Baker, Fauna B.I., Birds, vi, p. 195, 1929.

Vernacular Names.—*Kusya Chaha.* (Behar).

Description.—Upper part of head and neck, scapulars and a line over the shoulders in continuation, median wing-coverts and inner secondaries and primaries black; the longest secondaries greyish at the ends; the inner primaries with white bases; remaining plumage white.

Colours of soft parts.—Iris red-brown to red; bill black; legs and feet pale bluish-grey.

Measurements.—Wing 220 to 235 mm.; tail 86 to 90 mm.; tarsus about 84 to 90 mm.; culmen 84 to 91 mm. (*Hartert*).

In Winter the tail is greyish, the long secondaries more grey and less black.

Young birds have the black replaced by brown, the brown scapulars, coverts, etc., edged with paler brown, giving a mottled appearance.

Nestling in down.—Above pale grey; a black line through the lores and another down the centre of the crown with other black marks laterally; two broken dorsal lines of black and a well-developed black line down the posterior flanks joining round the tail; a few black blotches between this last and the dorsal lines; below dull white.

Distribution.—Breeding over the greater part of Europe; the Black Sea and the Caspian Sea to the Yenesei; Tropical Africa and South to North and Western India and Ceylon in winter.

Nidification.—The Avocet breeds nowhere within Indian limits but breeding colonies may be found as far west as Denmark and Spain. The colonies are sometimes of considerable size and the birds commence laying in the end of April, depositing their eggs either on the bare ground or in scratchings more or less well lined with vegetable debris. The site for the nest is in or around marshy land or sometimes in wet meadows of long grass, and the nest is generally well hidden, though I have seen nests occasionally in Denmark which were comparatively well exposed to any passer-by. The eggs, like those of all plovers, number four and are very like those of the Stilt, but average browner on the whole with rather darker and more definite markings, whilst they are also of course much bigger. Jourdain gives the average of a hundred eggs as 50.5 by 35.0 mm., max. 55.6 by 35.6 mm. and 50.4 by 37.5 mm.; min. 46.8 by 34.3 mm. and 48.3 by 31.2 mm.

Habits.—In India, this most beautiful bird occurs commonly in the North-West, from whence it decreases in numbers southwards, though it occurs in Ceylon whilst eastward it has occurred as far as

Behar. It arrives in India late in October though in the North-West a few birds may be met with in September, whilst Ticehurst has recorded it as early as the 28th of August. It leaves again in the end of March, the last few being seen as late as the second week in April. Ticehurst records having seen one as late as the 24th of May, whilst he saw yet another bird, apparently not breeding, on the 22nd of June at Jhimpir. In countries where it is more or less protected, the Avocet becomes very tame, but, where persecuted, it soon becomes very shy and wild, whilst in approaching its nest it is everywhere very cautious and suspicious. In India accounts of its wildness vary very greatly, and I have had it described to me by sportsmen as being sometimes exceptionally tame and confiding and at other times equally wild and difficult to approach. It keeps entirely to marshy lands, swamps and lakes, feeding on small crustacea, water insects, etc., obtaining its food by sweeping in the mud with a circular action of its curved bill as it walks quietly and slowly through the chalky shallows. It flies well, with its legs outstretched behind it and also swims well, sitting, like the Stilt, very high on the water. Witherby syllabifies its call as 'Klweet, klweet' and says that the male also has a low 'Chuck, chuck, chuck, chawy' which it utters on the ground.

GENUS: IBIDORHYNCHA.

Ibidorhyncha Gould, Century Birds, pl. 19 (1831).

Type by mon., *Ibidorhyncha struthersii* Gould.

This very curious genus still requires considerable study before its position can be finally settled. Pending this I follow Lowe in retaining it in the *Vanellina*.

The bill is hard, long, slender and curved downwards over nearly half its length; the nostril is linear and is placed at the base of the bill in a groove which extends over more than half the length of the bill; the tarsi are comparatively short and reticulated throughout; there is no hind toe; the outer and middle toes are connected by a deeply-indented small web, but that between the middle and inner toes is obsolete; the wing is very square, the first three primaries subequal and the inner secondaries almost as long.

IBIDORHYNCHA STRUTHERSII

The Ibis-Bill.

Ibidorhyncha struthersii Gould, Century Birds, pl. 19 (1831) (Himalayas); Stuart Baker, Fauna B.I., Birds, vi, p. 196, 1929.

Vernacular Names.—*Puggah* (Hill Miri).

Description.—Face as far back as the middle of the eye, throat and crown black bordered by white; the forehead and lores more or less speckled and streaked with white; neck, sides of head and upper breast bluish-grey, above merging into the ashy grey-brown of the upper plumage; rump-feathers with dark brown bases showing plainly; tail ashy-grey with narrow, wavy dark cross-bars, the other feathers with broad blackish subapical bars; primaries rather darker

brown, the inner webs marked with white, indefinite broad margins to the first three or four, becoming well-defined white spots and bars on the innermost; a narrow white band below the grey-blue upper breast followed by a broad black gorget; axillaries, under wing-coverts and rest of lower plumage white.

Colours of soft parts.—Iris crimson; bill deep crimson-red to scarlet-red; legs and feet pinkish-grey (non-breeding and young) to blood-red (breeding adults).

Measurements.—Wing 230 to 245 mm.; tail 113 to 120 mm.; tarsus about 47 to 49 mm.; culmen 68 to 80 mm.

Young birds have no black and white on the head; the black breast-band is wanting or only just shows; the upper plumage has each feather narrowly margined paler.

Nestling in down.—Above grey, this tint formed by the most minute stipplings of blackish and white with, here and there, a tinge of fulvous; a darker line round the back of the head; a well-defined black and rufous line down the posterior flanks and round the tail; below greyish-white.

Distribution.—The Pamirs and Gilgit to North-West China, in Winter moving down to the foot-hills all along the Himalayas. In Assam it is common in the hill-streams where they debouch from the hills but never wanders any distance into the plains. In the Himalayas, in Summer, it occurs principally between 9,000 and 15,000 ft.

Nidification.—The breeding of the Ibis-Bill was first discovered by S. L. Whympers in April 1906, when he obtained nests in the streams of the Garhwal Hills between 8,000 and 9,000 feet. The same year Lieut. F. M. Bailey obtained its eggs from Gyantse, in Tibet. Since then it has been found breeding by Osmaston, Ludlow and others in Tibet, up to an elevation of at least 13,000 feet, whilst La Touche also obtained several nests on the Shinho River in North-East Chihli. Mr. Whympers thus describes his finding of the eggs:

'On May 5, 1906, I found the Ibis-Bill (*Ibidorhynchus struthersii*) breeding on the Bhaghirathi river—at about 8,000 feet. I got three clutches of eggs (four in each), there being, so far as I could make out, only three pairs of birds there. The nests, composed of small stones, were hollowed out and placed on sand and shingle among boulders and were very like a large nest of the Spur-winged Plover. I found two of the nests by watching the birds, but the first one I found by tracing back the tracks of a bird that was crouching and running along in this manner and at once flew back when flushed. I had to trace the tracks back well over a hundred yards before I came to a well-trampled spot and the eggs were at the side of it.'

'I sat down some way off to watch and the bird returned in about five minutes (the eggs were very hard-set), running almost straight to the nest and stood over it bobbing her head like a plover. She then sat down alongside the eggs, not actually on them, and this seems to be a habit of theirs as I saw another bird act in the same way when returning to its nest. The eggs in the different clutches vary a good deal in size, but the largest are 1.95×1.45 and are shaped very like

a whimbrel's eggs. The ground colour is greenish-grey and they are spotted more or less all over but chiefly at the larger end with reddish-brown and pale purple, in colour and markings they are not unlike some terns' eggs. All the clutches were very hard set and indeed one would have hatched in a very few days. I was overjoyed at getting them, as I do not think they have been recorded before.'

'While hunting for these eggs I also found a fresh clutch of the Common Sandpiper (*Totanus hypoleucus*) in quite a neat little nest of twigs and pine needles under a boulder. I am not aware if this nest has been recorded from Indian limits before, though, of course, it breeds freely in Kashmir.'

Lieut. Bailey adds something to the description of the nest and says: 'The nest was situated on a stony island in the middle of the river here (13,000 ft.). The nest was made of small flat stones about $\frac{1}{2}$ inch in diameter, forming a perfectly smooth and flat surface. I unfortunately did not measure the nest. The eggs, four in number, were laid with their points inward. This nest was taken on the 9th June when the eggs were hard set. On the same day I saw two birds with two young ones each. On my approaching, the young birds lay among the stones with their necks stretched out flat on the ground while the old bird endeavoured to draw me off in another direction, uttering loud cries. The young when crouching among the stones were very difficult to see, and lay so still that they allowed themselves to be picked up before showing any signs of life. The other three eggs were accidentally broken, so I have not attempted to blow the remaining one.'

The birds breed at least as high as 14,000 ft. though more often between 8,000 and 11,000 ft., and Mr. Macdonald, who sent me several clutches of the eggs of this bird, informs me that they were nearly always taken on islands in the middle of streams, though occasionally one might be found on shingle beds running into the river from the banks. Mr. Whympers also refers to this predilection of the birds for islands and writes: 'They are especially fond of nesting on the little islands which are numerous and sometimes rather hard to get at.' The nest is always placed right out in the open; I never saw one under the shelter of a stone or stranded log as is mentioned in the *Birds of India*; a common site is near the edge of a shingle bank. The nest is usually found by keeping a sharp look-out ahead and the bird will be seen running stealthily away. If the nest is not immediately discovered the bird will return to it in a short time. I have found fourteen nests in a few days, the eggs of which were well incubated although I was a fortnight earlier than in 1906. In four nests I found incubated clutches of three eggs, so it seems they sometimes lay three only. The nests have already been described and all those I saw were made as before, of little smooth black stones.'

La Touche had two eggs of this bird brought to him by his collector in 1915 from a stream in the mountains of Chihli and, on the second of the May following, he himself went out and found numerous nests, mere depressions among the stones of the shingly beach. The depressions were lined with small stones, all of much the same size. The breeding season of this bird seems to be restricted to

April and May. The earliest I have recorded is one taken on the 9th of April by La Touche and the latest, with fresh eggs, is one taken on the 29th of May and with hard set eggs on the 11th June. Birds, however, have been seen in their breeding places after their eggs had been taken, haunting the vicinity, and I have no doubt that they lay again and later than May in these circumstances. The eggs, I think, remind one more of the Woodcock's eggs than those of any other wader, but they are very pale and weakly marked. The ground colour is a very pale grey, tinted either greenish, yellowish or buff, whilst markings consist of small blotches and spots of light to dark reddish, with secondary markings of pale lavender. Both types of markings are fairly numerous at the larger end but scanty elsewhere, and in no eggs are the markings at all bold. Fifty-two eggs average 51.0×36.9 mm.; maxima 53.0×36.0 mm. and 50.3×38.0 mm.; minima 46.0 by 34.0 mm.

Habits.—In summer the Ibis-Bill keeps entirely to the banks and islands of rivers, between 8,000 and 15,000 feet, or perhaps even higher still. In Winter they seem to remain sometimes as high as 12,000 feet as they have been seen on the Gyantse Plateau all the year round. On the other hand, the majority of birds appear to wander down to the foothills and are to be found on most of the Himalayan rivers, where they debouch into the plains, though they never wander far into them. In Winter this species seem to be more common in the foothills in Assam than anywhere else, and Stevens records them as being found regularly every year on the Subansiri and other rivers between November and March. I have myself seen them on many of these rivers and saw one small party containing half a dozen birds on the Dunsiri as late as the fourteenth of April. They are said to be very wild in the breeding season, not allowing anybody to come within a considerable distance, but in winter they are distinctly not wild and I found them easy to approach within sixty to a hundred yards as they fed at the water's edge. The birds I saw were walking quietly about, feeding on the shingle, every now and then turning over small stones to quest underneath them. Those on the bare shingle were feeding on insects of various kinds, small mollusca and sandhoppers, but one I shot feeding on some shingle upon which there was a certain amount of scrubby grass and equisetum, seemed to have been feeding entirely on small grasshoppers. This latter bird allowed me to sit and watch it for at least twenty minutes before it rose up to leave, and was shot. On the wing it is not unlike a large sandpiper, though not, I think, so swift, whilst during the breeding season it is said to indulge in all sorts of acrobatic feats in the air, much like a pee-wit. The only note I have heard is a musical 'klew, klew,' but it is said to have a loud harsh call of fear and a similar warning note to its mate when sitting. It is a very graceful bird, both when walking and flying, and always seemed to me to be particularly charming to watch, so much so that I always felt a regret at turning one into a specimen, even though the flesh was extremely good to eat after the skin had been made ready for the museum.

(To be continued)

REVISION OF
THE FLORA OF THE BOMBAY PRESIDENCY.

BY

E. BLATTER, S. J., Ph.D., F.L.S.

PART XVII

(With 3 plates and 1 text figure.)

(Continued from page 275 of this volume.)

ORCHIDACEÆ.

BY

E. BLATTER, S.J., Ph.D., F.L.S. & C. McCANN, F.L.S.

12. PACHYSTOMA Blume (not in Cke.).

Terrestrial herbs; rhizome underground, nodose. Leaves 1 or 2, long, narrow, plaited, often post-floral. Scape pale, with many sheaths. Flowers racemed, pendulous, moderate sized; bracts large, scarious. Sepals and petals subequal, lateral sepals adnate to the base of the column. Lip sessile at the base of the footless column, erect, side lobes oblong, midlobe small; disk with 3-5 deeply crested or fimbriate ridges. Column slender, clavate upwards. Anther dorsal, 4-celled; pollinia 8, pyriform.

Species 8.—British India, China, Malay Archipelago, Papuasia, N. Australia, New Caledonia.

1. *Pachystoma senile* Reichb. f. in Bonpland. iii, 250; Hook. f. in F. B. I. vi. 812; King & Pantl. Ann. Roy. Bot. Gard. Calc. viii, t. 140; Ridley F., Malay Pen. iv (1924) 116 (*P. sessile per errorem*); Brühl Orchids Sikkim (1926) 75; Fischer Fl. Madras pt. viii (1928) 1425.—*P. Smithianum*, *Edgeworthii*, *montanum* et *Lindleyanum* Reichb. f. l.c.—*Apaturia senilis*, *Smithiana* et *montana* Lindl. in Wall. Cat. 3739, 3737, 3738; Gen. & Sp. Orchid. 130, 131.—*A. Lindleyana* Wight l.c. t. 1662.

Description: Rhizome 2.5-5 cm. Leaf solitary, very long and narrow. Scape with raceme 20-70 cm. long, white or nearly so. Sheaths 12 mm.-5 cm. long. Flowers about 12 mm. long, glandular pubescent, white, greenish or pinkish. Bracts scarious, longer or shorter than the flowers, strongly nerved. Sepals membranous, acute or acuminate, 5-nerved. Petals narrowly spatulate, acuminate, 3-nerved. Mentum very short. Lip from oblong to nearly orbicular, claw very short; side lobes large, obtuse or subacute; midlobe as long or longer, oblong or obovate, retuse or pointed, purplish; disk with 5, rarely 3 crested ridges from the base to the midlobe, and there thickened. Column puberulous.

Locality: S. M. Country: Belgaum, in black soil of grass land, 2,600 ft., rainfall 50 in. (T. R. Bell 940! 941! 942! 943!).

Flowered beginning of March 1926. 'The flowers were out at the beginning of March. The leaves were not fully up and grown until towards the middle of August and there was not a vestige above ground before the middle of July.' (T. R. Bell in *epist.*)

Distribution: Plains and foot-hills of N. India, from Garhwal to Sikkim, Khasia Hills, Manipur, Malay Peninsula, W. Ghats of Bombay and Madras (apparently not in Ceylon).

13. THUNIA Reichb. f. (Cke. ii, 692).

Species 4.—Indo-Malayan. There is only 1 species in the Presidency.

1. *Thunia venosa* Rolfe in Orchid Rev. xiii (1905) 206; Cke. ii, 692; Haines Bot. Bih. & Or. 1167; Fischer Fl. Madras, pt. viii (1928) 1427.—*Phajus albus* Lindl. (*partim*); Hook. f. in F.B.I. v, 818 (*partim*).

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This species had been mixed up with *Thunia alba* Reichb. f. This latter species can, according to Rolfe, be distinguished by the somewhat elongate raceme, by more and much larger flowers, by a yellow disk to the lip and a few lilac radiating veins on the side lobes.

Distribution: Kumaon, Mussoorie, Sikkim, Assam, Khasia, Burma, Chota Nagpur, W. Ghats of Bombay Pres., Travancore.

14. CALANTHE Br. (not in Cke.)

Terrestrial herbs, often pseudobulbous with a short or tall, leafy stem. Leaves plaited. Scape axillary, terminal or lateral from a leafy pseudobulb. Flowers medium sized, racemed. Sepals subequal, spreading, rarely connivent. Petals broad or narrow. Lip adnate to the top or base of column, 3-lobed, midlobe often 2-fid, disk lamellate or tubercled, with or without a spur. Column long or short, obliquely truncate; foot O. Anther conical or convex, 2-celled; pollinia 8, waxy, cohering in pairs by a granular viscus.

Species 120.—Warm countries. One species in the Bombay Pres.

1. *Calanthe Masuca* Lindl. in Wall. Cat. 7337; Gen. & Sp. Orchid. 240; Bot. Mag. t. 4541; Hook. f. in F.B.I. v., 850; King and Pantl. Ann. Roy. Bot. Gard. Calc. viii, t. 234; Fischer Fl. Madras, pt. viii (1928) 1432; Brühl Orchids of Sikkim (1926) 108.—*C. versicolor* Lindl. Sert. Orchid. t. 42; Bot. Reg. 1844, sub tab. 37.—*C. emarginata* Wight Ic. t. 918.—*C. Wightii* Reichb. f. in Walp. Ann. vi, 933.—*Bletia Masuca* Don Prodr. 30.

Description: A terrestrial herb. Stem short, stout. Leaves elliptic-ovate to lanceolate, acuminate, 25–50 cm. long, 7–15 cm. broad, sessile, or base tapering into a usually short petiole, usually sparsely pubescent, at least below, sometimes glabrescent. Scape lateral, stout, with the lax-flowered raceme up to 90 cm. long, sparsely puberulous; bracts large, 20–25 mm. long, ovate-lanceolate, herbaceous, puberulous. Pedicels with ovary 3–3.7 cm. long. Flowers usually pale or dark purple, sometimes pale rose or white with a purple lip; lip always bright coloured, 20–25 mm. long, puberulous. Sepals lanceolate, up to 3.7 cm. long, lip hardly exceeding the sepals, side lobes short, falcate-oblong, midlobe much larger, broadly or cuneately reniform, spur linear-subspatulate, longer than the sepals. Capsule 3.5 cm. long.

Locality: N. Kanara: Malemanighat (Sedgwick 7216!).

Distribution: Tropical Himalaya from Nepal to Sikkim (1,500–4,000 ft.) Deccan Peninsula, W. Ghats of Madras Pres. (3,000–6,000 ft.), Java.

15. EULOPHIA R. Br. (Cke. ii, 693).

Species 200.—Warm countries of the Old World.

Cooke gives 4 species. We add another not known from the Presidency before: *Eulophia campestris* Wall.

A. Column not produced into a foot

I. Leaves and flowers coetaneous or nearly so

1. Lip longer than broad; side lobes of lip short or O

a. Sepals 12 mm. long; side lobes of lip O ... 1. *E. ochreatea*.

b. Sepals 2–2.3 cm. long; side lobes of lip 3 mm. long ... 2. *E. herbacea*.

2. Lip broader than long; disk of lip with 3 crested nerves ... 3. *E. pratensis*.

II. Flowers appearing long before the leaves ... 4. *E. campestris*.

B. Column produced into a foot ... 5. *E. nuda*.

1. *Eulophia ochreatea* Lindl. in Journ. Linn. Soc. iii (1858) 24; Dalz. & Gibs. Bomb. Fl. 265; Hook. f. F.B.I. vi, 2; Cke. ii, 693; Fischer Fl. Madras viii (1928) 1435.

Description: Cke 1. c.—Tubers sometimes 15 in a line. Scape up to 45 cm. Leaves dark green, plicate. Flowers pale cadmium yellow.

Locality: Gujarat: Khodwa, Panch Mahals (Raoji!).—Konkan (Stocks); Salsette, hills east of Tulsi Lake, in red earth in fairly open forest (McCann 1651! 1652! 1653!).—S. M. Country: Dharwar (Law).—Kanara (Law).

Distribution: Vizagapatam Hills at 3,000 ft.

2. *Eulophia herbacea* Lindl. Gen. & Sp. Orchid. (1833) 182; Dalz. & Gibs. Bomb. Fl. 265; Hook. f. in F.B.I. vi, 2; Cke. ii, 693; Fischer Fl. Madras pt. viii (1928) 1435; Duthie Ann. Roy. Bot. Gard. ix, t. 106.—*E. brachypetala*

Lindl. in Journ. Linn. Soc. iii, 24.—*Limodorum bicolor* Roxb. Fl. Ind. iii, (1832) 469.—*Eulophia carinata* Grah. Cat. p. 202 (non Lindl.)

Distribution: W. Himalaya, Garhwal, 4,000–7,000 ft., Bengal, Rungpore, Gujarat, Konkan, Kanara, Bababudun Hills in Mysore.

3. *Eulophia pratensis* Lindl. in Journ. Linn. Soc. iii (1858) 25; Dalz. & Gibs. Bomb. Fl. 264; Hook. f. F.B.I. vi, 4; Cke. ii, 694; Fischer Fl. Madras. pt. viii (1928) 1435.—*E. ramentosa* Wight Ic. t. 1666 (non Lindl.)—*E. virens* Grah. Cat. 202 (non Brown).

Locality: *Gujarat*: Panch Mahals (Raoji!).—*Deccan*: Poona (Woodrow 965!); canal-side, Poona (Herb. Econ. Bot.!).; Pishan, 6 miles W. of Poona (Tukaram!, Paranjpe!, Gammie!).—*W. Ghats*: Panchgani (A. St. J. Cooke).—*S. M. Country*: Belgaum (Ritchie 1421); Dharwar, in grass, 2,400 ft., rainfall 34 in. (Bourne 3481!); Havasbhavi in Dharwar Dist., in long grass, not common, 2,000 ft., rainfall 33 in. (Sedgwick 2146!).—*N. Kanara*: Haveri (Talbot 2225!).—Hook. f. says from the Konkan southwards. We have not seen any specimen from those parts.

Flowers: Nov. 1919 (Dharwar), Dec. 1917 (Dharwar).

Distribution: Deccan, S. M. Country, W. Ghats of Madras Pres.

4. *Eulophia campestris* Wall. Cat. 7617; Lindl. Gen. & Sp. Orchid. 185; in Journ. Linn. Soc. iii, 24 (excl. syn. Wight); Hook. f. F. B. I., vi, 4; Haines Bot. Bih. & Or. 1171.—*E. ramentacea et rupestris* Lindl. in Wall. Cat. 7367, 7368; Gen. & Sp. Orchid. l.c.—*E. hemileuca* Lindl. in Journ. Linn. Soc. iii, 25.—*Limodorum ramentaceum* Roxb. Hort. Beng. (1814) 69; Fl. Ind. iii., 46.—*Bletia Dabia* Don Prodr. 30.

Description: A slender orchid. Flowering stem 15–16 cm., rising laterally from the apex of a chain of erect ovoid tubers which are connected at their base (Haines). Sheaths subappressed, acute. Leaves 2, rising from the apex of the slender sheathing pseudostem, developing long after the plant has flowered, 25–40 cm. long, linear, acuminate. Scape sheathed at intervals by loose membranous bracts. Flowers many in lax racemes, sometimes secund or subsecund, or nodding on slender pedicels. Floral bracts variable, membranous, linear or lanceolate, acuminate, usually longer than the slenderly stalked ovary. Sepals slightly attached to the base of the lip, 8–12 mm., linear-lanceolate, or linear-oblong, acute or acuminate, 5–7-nerved. Petals elliptic or broadly oblong, obtuse, or lanceolate, as or nearly as long as the sepals, 5–6 mm. broad, broader than the sepals, 3–5 nerved, greenish or yellowish, with red or brown clouds. Lip 9–11 mm. long, oblong or cuneate-obovate; side lobes short, rounded or subacute, erect or upcurved, adnate to the column, veined with red, midlobe orbicular, quadrate or oblong, crenulate, purple? or yellow?, basal portion of disk with 3 median lamellae, ending in a fimbriate or tubercled patch on the terminal lobe. Spur short or hardly any, obtuse, conical subclavate. Column as long as the lip, slender, without a foot or scarcely any. Pollinia 2, broad, notched and perforated near the base; caudicle stout; gland elongate. Capsule 18 mm. long, ellipsoid.

Note.—The various botanical writers do not agree on several details of morphology. Their statements show that the plant is an extremely variable one or that further observations are required on several points. We mention only a few:

Tuber:

'From a deformed tuber.' (Hook. f.).

'From the last of a chain of erect tubers which are connected at their base.' (Haines).

Colour of flower:

'Flowers yellowish or green with pink or purple markings.'

'Flowers pale pink with darker lines.' (Brühl).

'Sepals yellow or green, striped with pink.' (Hook. f.).

'Sepals and lateral petals green. Lip white, strongly green-veined.' (Hallberg in MS.).

'Sepals greenish outside, brownish inside.' (Haines).

'Petals greenish or yellowish with red or brown clouds.' (Haines).

'Side lobes of lip beautifully veined with red.' (Haines).

'Midlobe usually purple.' (Hook. f. and Duthie).

'Midlobe yellow.' (Haines).

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- Nerves of sepals : 'Sepals 5-nerved.' (Haines).
 'Sepals 5-7-nerved.' (Hook. f. and Duthie).
 Size of sepals and petals : 'Petals broader than the sepals.' (Haines).
 'Petals narrower than the sepals.' (Hook. f. and Duthie).
 Shape of petals : 'Petals oblanceolate.' (Hook. f. and Duthie).
 'Petals elliptic or broadly oblong.' (Haines).
 We found them lanceolate.
 Ridges on palate of lip : '3 median lamellae.' (Hook. f. and Duthie, Brühl).
 '2 crenulate lamellae.' (Haines).
 Our specimen shows 2 lamellae.

Locality : *Konkan* : Bombay, Victoria Gardens, wild (Hallberg 15377 !).

Flowers : April in Bombay.

Distribution : Baluchistan, Afghanistan, sub-Himalayan tracts of Rohilkhand and N. Oudh, Nepal, Sikkim (Terai and Duars), Bengal, Chota Nagpur, Chittagong, Upper Burma, Deccan.

5. *Eulophia nuda* Lindl. in Wall. Cat. (1823) 7371: Hook. f. F.B.I. vi, 5; King & Pantl. in Ann. Roy. Bot. Gard. Calc. viii (1898) 180, t. 243; Duthie *cod. l.* ix, pt. ii, 127; Prain Beng. Pl. 1016; Cke. ii, 695; Duthie Fl. Upper Gang. Plain iii, pt. ii (1920) 200; Haines Bot. Bih. & Or. 1171; Brühl Orchids Sikkim (1926) 109; Fischer Fl. Madras viii (1928) 1435; Trim. Fl. Ceyl. pt. iv (1898) 177.—*E. bicolor* Dalz. in Kew Journ. Bot. iii (1851) 343; Dalz. & Gibs. Bomb. Fl. 264.—*Cyrtopera fusca* Wight Ic. (1852) t. 1690 (*Cke. habet Cyrtopera per errorem*).—*C. nuda* Reichb. f. in Flora (1872) 274.—*C. mysorensis* Lindl. in Journ. Linn. Soc. iii, 32.

Description : Cke. ii, 694. More complete in Duthie Fl. Upper Gang. Plain iii, 200.

Locality : *Konkan* : Ambenali at foot of Mahabaleshwar (Blatter & McCann!).—*S. M. Country* : Ramghat (Ritchie!); Amba, Manoli forest (Bhide!); Londa (Ahmed Khan 2541!).—*N. Kanara* : Kalanaddi (Ritchie 708); foot of Arbail Ghat, 800 ft. (Sedgwick 6646!).

Flowers : Jan. 1917 (Londa).

Fruit. Oct. 1919 (N. Kanara).

Distribution : Tropical Himalaya from Nepal to Sikkim, N. Oudh, Chota Nagpur, Assam, Khasia Hills, Manipur, Burma, Pegu, Tenasserim; W. Peninsula, W. Ghats of Madras Pres., 2,000-7,000 ft.; Vizagapatam Hills at 3,800 ft., Ceylon.

16. *GEODORUM* Jackson (Cke. ii, 695).

Species 10.—Indo-Malayan.

One species in the Bombay Pres. We follow Fischer in changing *Geodorum dilatatum* R. Br. into *G. densiflorum* Schlechter.

1. *Geodorum densiflorum* Schlechter in Fedde Report Beih. iv (1919) 259; Fischer Fl. Madras. viii (1928) 1437.—*Limodorum densiflorum* Lam. Encycl. iii, 516.—*Geodorum purpureum* Hook. f. F. B. I. vi (1890) 16; Dalz & Gibs. Bomb. Fl. 266; King & Pantl. in Ann. Roy. Bot. Gard. Calc. viii (1898) 181, t. 245; Duthie *cod. l.* ix, pt. ii, 130.—*G. dilatatum* R. Br. in Ait. Hort. Kew. ed. 2, v (1813) 207; F. B. I. vi, 17; Wight Ic. t. 912; Prain Beng. Pl. 1017; Cke. ii, 695; Haines Bot. Bih. & Or. 1170; Duthie Fl. Upper Gang. Plain iii, pt. ii (1920) 203.—*Limodorum recurvum* Roxb. Corom. Pl. i (1795) t. 30; Fl. Ind. iii (1832) 469.

Description and Locality : Cke. ii, 695.

Distribution : Dehra Dun, Nepal, Sikkim, Bhutan, Assam, Bengal, Andaman Islands, Konkan, N. Kanara, all districts of the Madras Pres. between 200-3,000 ft., Ceylon, China.

17. *CYMBIDIUM* Swartz (Cke. ii, 696).

Species 30.—Africa to Australia.

1. *Cymbidium aloifolium* Swartz in Nov. Act. Upsal. vi (1799) 73; Hook. f. F.B.I. vi, 10 (*partim*); Lindl. Gen. & Sp. Orchid. Grah. Cat. 203; Dalz. &

Gibs. Bomb. Fl. 266; Roxb. Fl. Ind. iii (1832) 458; Wight Ic. tt. 1687, 1688; King & Pantl. in Ann. Roy. Bot. Gard. Calc. viii (1898) 189, t. 252; Duthie *ed.* 1. ix, pt. 2, 135; Fl. Upper Gang. Plain iii, pt. ii (1920) 204; Cke. ii, 696; Brühl Orchids Sikkim (1926) 115; Fischer Fl. Madras, pt. viii (1928) 1436.—*C. bicolor* Hook. f. F. B. I. vi, 11 (*non* Lindl.); Trim. Fl. Ceyl. iv (1898) 179.—*Epidendrum pendulum* Roxb. Corom. Pl. t. 44.

Description: Cke. ii, 696.

Locality: Add: *Konkan*: Savantvadi at Tamboli (F. X. Miranda!).

Flowers: May 1903 (Poona, in garden).

Fruit: Jan. (Savantvadi).

Distribution: Sikkim, Bengal, Assam, Andaman Islands, Konkan, Kanara, all hilly tracts of Madras Pres., 100–3,500 ft.

18. SARCOCHILUS Br. (Cke. ii, 697).

Species about 40.—Indo-Malayan, Polynesian.

We retain the 2 species given by Cooke.

- | | | |
|--|-----|-----------------------------|
| 1. Racemes shorter than the leaves | ... | 1. <i>S. viridiflorus</i> . |
| 2. Racemes much longer than the leaves | ... | 2. <i>S. maculatus</i> . |

1. *Sarcochilus viridiflorus* T. Cooke (*non* Hook. f. in F. B. I. vi, 38); Cke. ii, 697.—*Saccolabium viridiflorum* Lindl. in Journ. Linn. Soc. iii (1853) 36; Hook. f. F. B. I. vi, 63.—*Micropera viridiflora* Dalz. in Kew Journ. Bot. iii (1851) 282.

Description: Cke. i. c.

Locality: *Konkan* (Dalzell).—*W. Ghats*: Mahableshwar (Cooke!); Koina valley below Mahableshwar (Cooke); Castle Rock (Bhide!); Amboli Ghat (Gammie 15067!).—*S. M. Country*: Amba (Bhide!).—*N. Kanara*: Usheli (Ritchie 1426); Chandwar (Ritchie 1426); Tinai Ghat (Bhide!).

Distribution: Endemic in the Bombay Pres.

2. *Sarcochilus maculatus* Benth. in Benth. & Hook. f. Gen. Pl. iii (1883) 575; Cke. ii, 698.—*Saccolabium maculatum* Hook. f. F. B. I. vi (1890) 64.—*Micropera maculata* Dalz. in Kew Journ. Bot. iii (1851) 282; Dalz. & Gibs. Bomb. Fl. 263.

Description, etc.: Cke. ii, 698.

Locality: *W. Ghats*: (Dalzell); Phunda Ghat (Ritchie 1427!).—*N. Kanara*: Idigangi (Bell); Kadra (Bell!); Yellapur 1,600 ft. (Sedgwick 5834!).

Flowers: May 1911 (N. Kanara).

Fruit: Aug. 1919 (N. Kanara).

Distribution: Endemic in Bombay Pres.

19. CHILOCHISTA Lindl. (*not in* Cke.).

Epiphytic herbs; stem very short, leafless, scaly; roots slender, long. Racemes erect. Sepals and petals similar, broad, spreading, the lateral sepals inserted on the apical portion of the foot. Petals usually running down the foot. Lip movable on the foot, 3-lobed, spur saccate, side lobes erect, midlobe very short; disk with a pubescent callus. Column short; foot broad. Anther 2-celled, pollinia 2, globose, deeply furrowed, caudicle short.

1. *Chilochista glandulosa* sp. nov. Blatter & McCann.

[*Orchidacea vicina Chilochistae pusillae* Schlechter *sed differet ab ea bracteis ovario aequilongis, pedunculis, pedicellis necnon ovariis densissime glandulis albis conicis coopertis, floribus flavis maculis brunneo-rubris ornatis.*]

Description: A very small epiphytic plant. Roots loosely tufted, tortuose, up to 15 cm. long and about 2 mm. broad, flattened, when fresh white-satin with a pinkish tinge, running along the underside of branches. Stem o. Leaves none. Peduncle and raceme about 3–4 cm. long, thin at insertion, thickening upwards, bearing 2–4 flowers, jointed, with a bract at base and at each joint about the same length as the bracts subtending the flower. Peduncles, pedicels and ovaries thickly covered with minute white conical glandular hairs. Racemes about 15 mm. long. Bracts as long as the sessile ovary, 1.5 mm. long, glabrous, veined longitudinally, straw-coloured. Flowers distichous. Sepals yellow, spotted and blotched irregularly and usually densely with brown-red. Dorsal sepal broadly oblong, 5 mm. long, 2.5–3 mm. broad, subobtusate; lateral sepals broadly oblong, subacute, 3–3.5 mm. long, 2 mm.

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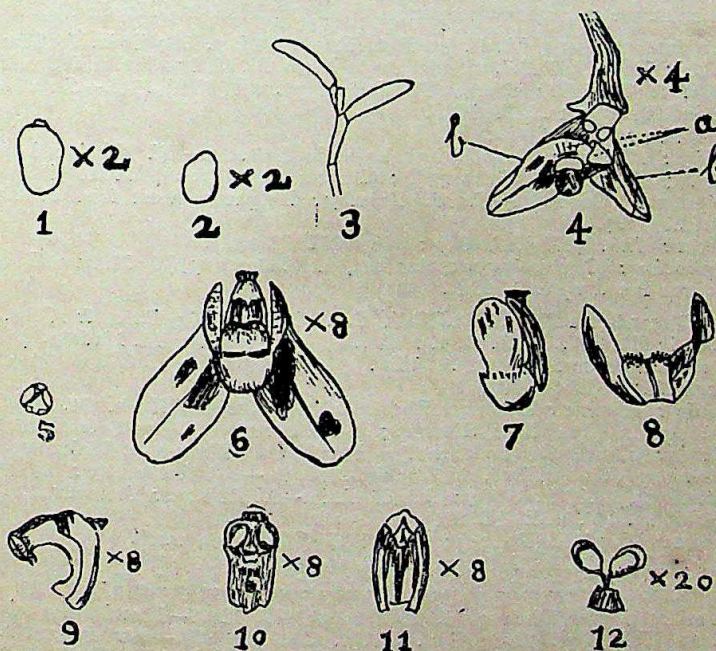
broad. Petals slightly longer than lateral sepals, narrower and subacute at apex, the same colour as the sepals. Lip 3-lobed, 2-3 mm. long, inflexed upon the foot of the column; side lobes more than twice as long as the midlobe, reaching to beyond the inflexed column, then curving towards each other and meeting, even overlapping; midlobe short rounded, slightly emarginate; each little roundish lobe due to the emargination, white-woolly, the wooliness only slightly encroaching upon the upper side of the lip (not visible owing to the inflexion of the whole lip). Column very short, scarcely 1 mm. long, somewhat curved, very much bent inwards towards the long foot (about 1 mm. long) to which the lip is joined, white, with the foot purple-blotched. Cap broad, obcordate, yellowish. Rostellum square, transparent, coming away with the gland. Pollinia 2, obovate, slightly compressed, deeply grooved; caudicles short, extensible. The stigmatic surface seems to be a hollow immediately under the rostellum on the front face of the column. Fruit 11 by 2 mm., light green, speckled and blotched with purplish brown, curved thickest in the middle, gradually narrowed into the rhachis, 4-sided, the dorsal and lateral faces slightly ridged down centres, the ventral face broadest with a broad low central longitudinal thickening, the whole surface covered with minute, erect conical whitish glandular hairs. (Most of the description from Bell's MS. prepared from live specimens.)

Locality: N. Kanara: Karwar (T. R. Bell 4969, type); Dandulli (T. R. Bell); Yellapur, on *Careya arborea* and *Randia uliginosa* (T. R. Bell).

Flowers: Jan. 1912 (Yellapur).

Fruit: June (Karwar).

Note: It is useful to remember that Schlechter has united *Chilochista usneoides* Wight Ic. t. 1741 and *Sarcohilus Wightii* Hook. f. under the name of *Chilochista pusilla*.



Chilochista glandulosa sp. nov. Blatter & McCann:

1. Dorsal sepal, $\times 2$. — 2. Lateral sepal, $\times 2$. — 3. Fruit. — 4. a. Side-lobes of lip, $\times 4$. — b. Petals, — 5. Cap, — 6. Flower, $\times 8$. — 7. Attachment of dorsal sepal. — 8. Lip — 9. Side view of column and foot, $\times 8$. — 10. Top view of same, $\times 8$. — 11. Front view of column, $\times 8$. — 12. Pollinia with gland, $\times 20$.

20. RHYNCHOSTYLIS Blume (Cke. ii, 698).

Species 2.—Indo-Malayan.

1. *Rhynchostylis retusa* Blume Bijdr. (1825) 286, t. 49; Hook. f. F.B.I. vi, 32; King & Pantl. in Ann. Roy. Bot. Gard. Calc. viii (1898) 213, t. 284; Trim. Fl. Ceyl. iv, 187; Prain Beng. Pl. 1020; Haines Bot. Bih. & Or. 1178; Brühl Orchids Sikkim (1926) 128; Fischer Fl. Madras, pt. viii (1928) 1440; Cke. ii, 698.—*Saccolabium guttatum* Lindl. in Wall. Cat. (1828) 7303; Dalz. & Gibs. Bomb. Fl. 263; Wight Ic. tt. 1745, 1746; Bot. Mag. t. 4108.—*Aerides retusa* Sw. in Schrad. Journ. II (1799) 233; Grah. Cat. 294.—*A. guttatum* Roxb. Fl. Ind. III (1832) 471.—*Epidendrum retusum* Linn. Sp. Pl. (1753) 1351.

Description: Cke. ii, 698.

Locality: Konkan: (Stocks); Salsette (Dalzell & Gibson, Herb. St. X. C. 8691!); Thana (Ryan 49!); between Chandan and Karjat (Blatter & Hallberg 26534!).—S. M. Country: Lanze, on Kolhapur-Ratnagiri Road (R. K. Bhide!); W. of Dharwar (Mrs. Wilkinson 4018!).—N. Kanara: Kalanaddi (Ritchie).

Flowers: May 1904 (S. M. Country); June 1918 (W. of Dharwar); July 1918 (Salsette).

Distribution: Tropical Himalaya from the Punjab eastwards to Nepal, Sikkim and Bhutan, up to 4,000 ft., Assam, Khasia Hills, Chota Nagpur, Konkan, Kanara, Deccan, Circars, Walayar, Malabar Coast, Ceylon, Burma, Malay Peninsula, Siam, Java, Philippines.

21. AERIDES Lour. (Cke. ii, 699).

Species about 50.—Eastern Asia.

Cooke mentions 3 species: *A. maculosum*, *A. crispum* and *A. radicosum*. For the latter we substitute the name *A. ringens* Fischer. Key in Cke. i. c.

1. *Aerides maculosum* Lindl. in Bot. Rep. (1845) t. 58; Dalz. & Gibs. Fl. Bomb. 266; Hook. f. F.B.I. vi, 45; Prain Beng. Pl. 1020; Cke. ii, 699; Haines Bot. Bih. & Or. 1182; Fischer Fl. Madras, pt. viii (1928) 1442.—*Saccolabium speciosum* Wight Ic. tt. 1674, 1675.

Description: Cke. ii, 699.

Locality: Konkan: Near Vehar Lake in Salsette.—W. Ghats: Lonavla (Garade!); Khandala (Hallberg!); Panchgani (Cooke, Alice Pigott!); Mahabaleshwar (Cooke!).—S. M. Country: Belgaum, west face of Cheeta Hill (Ritchie 713).

Flowers: Jan. 1927 (Salsette); May 1902 (Poona).

Distribution: Chota Nagpur, Konkau, S. M. Country, W. Ghats of Bombay and Madras Pres., up to 4,500 ft.

2. *Aerides crispum* Lindl. in Wall. Cat. (1828) 7319; Dalz. & Gibs. Fl. Bomb. 265; Hook. f. F.B.I. vi, 45; Cke. ii, 700; Fischer Fl. Madras, pt. viii, 1442.—*A. Lindleyana* Wight Ic. t. 1677.

Description: Cke. ii, 700.

Locality: Konkan: Between Khandala and Karjat (Herb. St. X. C.!); near Vengurla (Dalzell & Gibson); Wari country (Dalzell & Gibson).—W. Ghats: Khandala (Hallberg!); Panchgani (Blatter!); Mahabaleshwar, very common (Blatter 230!; M. Ezekiel 26572!).—S. M. Country: Devarayi, S. M. Railway, 1,800 ft. (Sedgwick 4087 bis!).—N. Kanara: Yellapur, 1,500 ft., rainfall 100 in. (T. R. Bell 6061!).

Flowers: May 1903 (Poona); June 1925 (Mahabaleshwar).

Fruit: March 1917 (Between Khandala and Karjat).

Distribution: Bombay Pres., Nilgiri and Pulney Hills, 3,000-4,000 ft.

3. *Aerides ringens* Fischer Fl. Madras, pt. viii, 1442.—*Saccolabium ringens* Lindl. in Wall. Cat. 7313; Gen. & Sp. Orchid. 220.—*Aerides radicosum* A. Rich. in Ann. Sc. Nat. ser. 2, xv (1841) 65, t. 1, fig. C.; Hook. f. F.B.I. vi, 46; Cke. ii, 700.—*A. lineare* Hook. f. l. c. 47; Trim. Fl. Ceyl. iv (1898) 189.—*Saccolabium lineare* Lindl. in Wall. Cat. 7312.—*S. paniculatum* Wight Ic. t. 1676.—*S. Wightianum* Lindl. in Wall. Cat. 7303; Gen. & Sp. Orchid. 221 (excl. syn.); Wight Ic. t. 917.—*S. rubrum* Wight Ic. 1673 (non Lindl.).

As *Aerides ringens* Fischer is a combination of 2 species which were considered to be distinct before, we are going to give a description including the characters of *A. radicosum* and *A. lineare*.

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PLATE IX.



Del. C. McCann after Miss E. Bell.

Luisia truncata Blatter and McCann, *sp. nov.*

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Description : Stem short, 4-17 cm. long, as thick as the thumb, with very stout simple vermiform roots. Leaves thickly coriaceous, 10-42 by 0.1-2.5 cm.; scymitar-shaped, linear or linear-oblong, unequally 2-lobed at the apex, keeled, often mottled with purple, bases closely imbricating. Flowers from nearly white to deep rose-pink, in simple or branched racemes or panicles shorter or longer than the leaves; bracts minute, ovate, acute, persistent; pedicels with ovary 6-16 mm. long. Sepals suborbicular; lateral sepals 6 mm. long and as broad as long, broadly elliptic or suborbicular; dorsal sepal 8 by 4 mm., elliptic, obtuse. Petals narrower. Lip 3-lobed; side lobes very small; midlobe ovate; disk with 2 large basal calli; spur cylindric, obtuse, incurved. Anther beaked; caudicle of pollinia short, subtriangular; gland large.

Locality : Konkan : Salsette (Dalzell & Gibson).—W. Ghats : Mahableshwar (Woodrow !).—S. M. Country : W. of Astoli (Sedgwick 2523 !).—N. Kanara : Near Kanapa on the Kalanaddi (Ritchie 715); in forests (T. R. Bell 4089 !).—Growing on trees and rocks.

Flowers : July 1917 (S. M. Country).

Distribution : Konkan, S. M. Country, N. Kanara, W. Ghats of Bombay and Madras Pres., 800-8,000 ft., Ceylon.

22. *LUISIA* Gaud. (Cke. ii, 791).

Species 35.—Tropical Asia to Japan.

Cooke gives 2 species as belonging to the Bombay Pres. We add 4 new species.

Key :

- I. Petals as long as the lateral sepals or only slightly longer
 1. Petals linear-oblong, obtuse ... 1. *L. teretifolia*.
 2. Petals strap-shaped, truncate ... 2. *L. truncata*.
- II. Petals much longer than the lateral sepals
 1. Leaves not caudate
 - a. Leaves rounded at apex ... 3. *L. tenuifolia*.
 - b. Leaves sharp-pointed at apex ... 4. *L. pseudotenuefolia*.
 - c. Leaves rounded at apex with a short conical apiculus ... 5. *L. macrantha*.
 2. Leaves long-caudate ... 6. *L. Evangelinae*.

1. *Luisia teretifolia* Gaud. Bot. Freyc. Voy. (1826) 427, t. 37; Hook. f. F.B.I. vi, 22; King & Pantl. in Ann. Roy. Bot. Gard. Calc. viii (1898) 202, t. 271; Trim. Fl. Ceyl. iv, 190; Prain Beng. Pl. 1018; Brühl Orch. Sikkim (1926) 123; Fischer Fl. Madras, pt. vi, (1928) 1438.—*Cymbidium triste* Roxb. Hort. Beng. (1814) 63; Bot. Mag. t. 3648; Wight Ic. t. 911 (*text. tantum*).—*C. tenuifolium* Wight. Ic. t. 1689 (*textu excl.*).

Locality : Konkan : Vettora (Sabnis !).—S. M. Country : Devicop (Sedgwick 5786 !).—N. Kanara : Usheli (Ritchie 1417); Wadehukli, 1,500 ft. (T. R. Bell 6078 ! *bis.*), in forests (T. R. Bell 5414 !).

Flowers : May 1919.

Distribution : Sikkim, Khasia Hills, Bengal Pegu, Andamans, Konkan, S. M. Country, N. Kanara, W. Ghats of Madras Pres., 3,000-4,000 ft., Vizagapatam Hills at 4,000 ft., Ceylon.

2. *Luisia truncata* sp. nov. Blatter & McCann. [*Orchidacea vicina Luisiae teretifoliae* Gaud. et *L. brachystachyae* Blume, sed differt ab eis foliis apice apiculatis petalis liguliformibus apice truncatis et epichilio 3-lobulato.]

Description : Stem stout; internodes short. Leaves comparatively stout, up to 11 cm. long, spreading, flexuose, uniformly thick throughout, green or greenish, blotched with purple, apiculate at apex. Rhachis a few mm. long, few-flowered (about 3). Flowers small, about 10 mm. wide. Dorsal sepal up to 5 mm. long, a little more than 2 mm. broad, oblong, acute, slightly concave, tip incurved yellowish green outside, greenish purplish inside. Lateral sepals ovate, subacute, boat-shaped, size of dorsal sepal, yellowish green outside, spotted with dingy purple inside. Petals slightly longer than sepals, strap-shaped, truncate at apex, greenish yellow on both sides, spreading, tips bent forward and downwards. Lip

in general outline obovate, a little longer than the sepals, about 7 mm., purple, deeply constricted between hypochile and epichile; hypochile quadrate, concave, a little shorter than the epichile, distal corners rounded; epichile broadly ovate, broader than hypochile, 3-lobulate, all lobules rounded, central one double the diameter of the lateral ones, a few yellow streaks from the constriction forward. Anther 2-celled. Capsule shortly stalked, about 18 mm. long, 3-4 mm. diam., slightly thicker upwards, but again contracting towards the apex. (Described from detailed coloured illustrations prepared under T. R. Bell's direction by Miss E. Bell.)

Locality: N. Kanara: Yellapur (T. R. Bell).—W. Ghats: Castle Rock (T. R. Bell).

Flowers: May 1911.

Fruit: July 1911.

3. *Luisia tenuifolia* Blume Rumph. iv (1848), 50; Dalz. & Gibbs. Fl. Bom. 266; Hook. f. F.B.I. vi, 24; Trim. Fl. Ceyl. iv, 191; Fischer Fl. Madras pt. vi (1928) 1438.—*Cymbidium triste* Wight Ic. t. 911 (*ic. tantum*).—*C. tenuifolium* Lindl. Gen. & Sp. Orchid. (1833) 167; Grah. Cat. 203.

Locality: Add: W. Ghats: Castle Rock (Bhide!).

Distribution: Konkani, N. Kanara, W. Ghats of Bombay Pres., Madras Pres.: W. Ghats, Melpat in S. Arcot, near sea-level to 4,000 ft.

4. *Luisia pseudotenuifolia* sp. nov. Blatter & McCann.

[*Orchidacea similis Luisia tenuifolia* Blume a qua tamen differt caulibus internodiis longis, foliis ad apicem acumine praeditis sepalo laterali apiculato, sepalo dorsali lineari, longitudine petalorum et labii relativa.]

Description: Stem very long, slender; internodes long, 2-2.5 cm. Leaves up to 20 cm. long, very thin, mostly straight, spreading, forming a knee 2 or 3 cm. from the apex and at the same time becoming much thinner and finally ending in a very thin sharp point. Rhachis of spikes few-flowered, up to 14 mm. long, considerably thinner than the stem. Dorsal sepals linear, rounded at apex, 10 mm. long, 2-3 mm. broad; lateral sepals ovate-oblong, broadly apiculate, concave, 10 mm. long, 3-4 mm. broad. Petals linear, obtuse at apex, slightly broadening and bent in the upper half, about 20 mm. long, 2-3 mm. broad. Lip narrowly panduriform, 13-14 mm. long, 3-4 mm. broad, with 2 small rounded spreading lobes at the base and 2 short square, diverging lobes at the apex, these lobes about 2 mm. long and over 1 mm. broad. Column stout, much shorter than the lip. Pollinia 2, ovoid. Fruit not seen.

Locality: N. Kanara: In forests (T. R. Bell 5401, type, 5411, cotype).—Found by T. R. Bell in 1907.

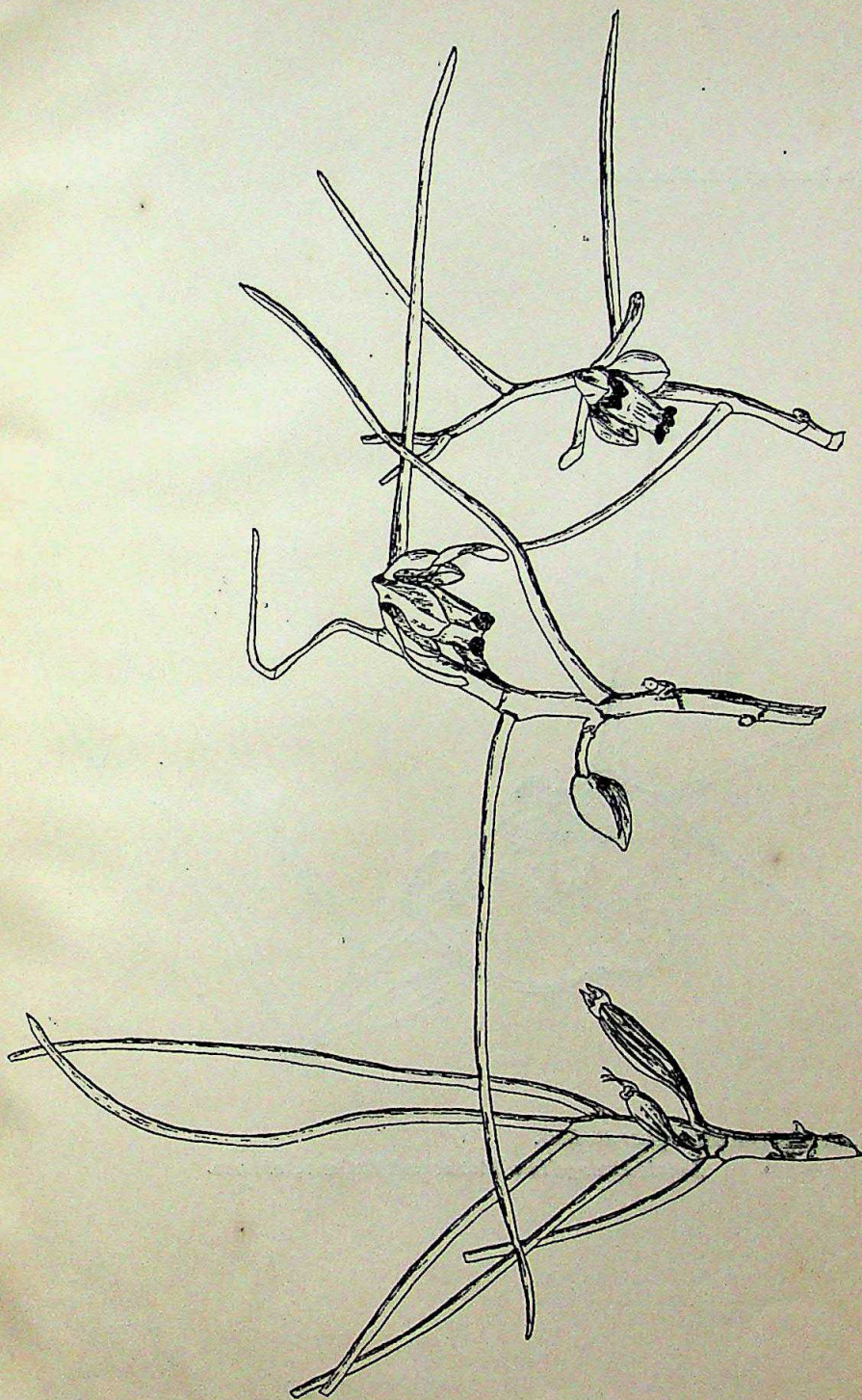
5. *Luisia macrantha* sp. nov. Blatter & McCann.

[*Orchidacea ab omnibus aliis Luisia speciebus distinguitur florum magnitudine multo maiore, petalis linearibus 4 cm. alligentibus. Differt a Luisia tenuifolia* Gaud. cui est vicina labio late oblongo, foliis apice conico-apiculatis, partibus omnibus multo maioribus.]

Description: Stem more than 50 cm. high, stout, almost uniformly so from base to tip, branched or unbranched, dark brown with green shade, branches almost the same thickness as the stem; internodes 2.5-3.5 cm. long; roots vermiform, stout, up to 20 cm. long. Leaves up to 20 cm. by 3 mm., cylindrical, variable in thickness, light or dark green, spreading or ascending, straight or flexuose, the tip bluntly rounded with a short conical apiculus at outer side. Buds triangular in section, subobtusate at apex, arising from a woody cylindrical support which is covered with membranous closely appressed brownish grey sheaths, with more opaque, lighter coloured annular edges. Flowers few short in extraaxillary usually 1-flowered spikes reaching with the peduncle about 2.5 cm., very large, measuring in their natural state 3 by 3 cm., when spread out, up to 8 cm. wide and over 6 cm. from the tip of the dorsal sepal to the end of the lip. Sepals equal in size, boat-shaped, 1.6-2.5 by 1-1.5 cm., slightly submarginate-apiculate at apex, surface shagreened, apple-green, blotched with purplish red, lateral sepals underneath mostly purple-red. Petals long and narrow, linear, pointed obliquely at apex, curved outwards and then inwards, 2.5-4 cm. by 3 mm., apple-green outside and on the distal half of the inside, the basal half of the inside nearly completely purple-red. Lip broadly oblong, slightly dilated before middle, somewhat constricted just before the

PLATE X.

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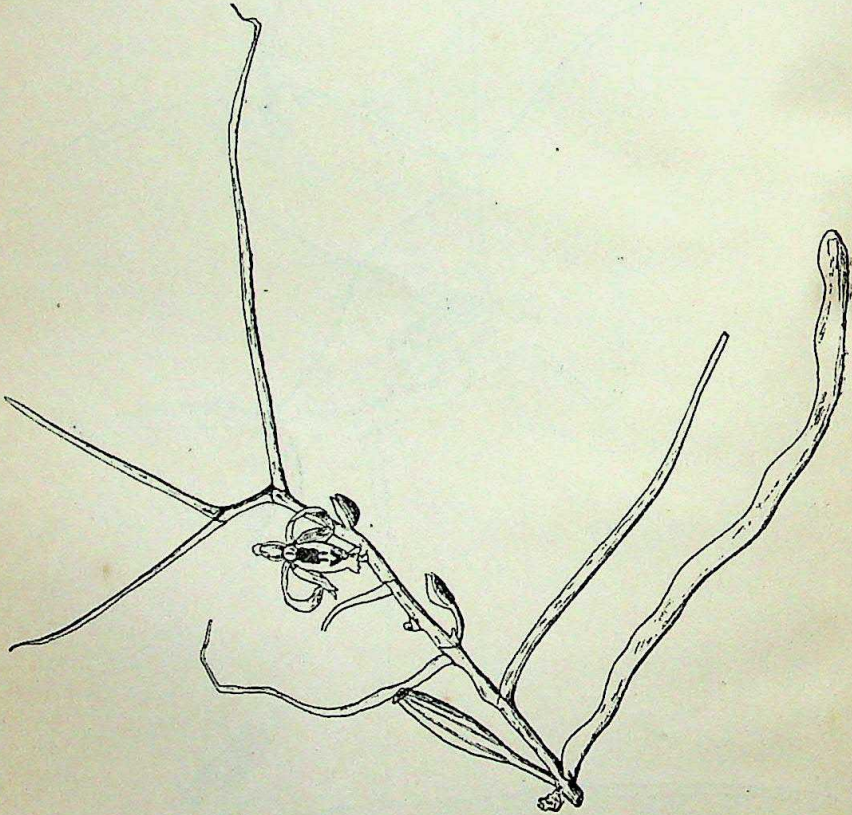


Del. C. McCann after Miss E. Bell.

Luisia macrantha Blatter and McCann, *sp. nov.*

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PLATE XI.



Del. C. McCann after Miss E. Bell.

Luisia Evangelinæ Blatter and McCann, *sp. nov.*

endlobes, 2.5-3 cm. long, 5-8 mm. across where broadest, 6 mm. broad at base, endlobes well developed, rounded, diverging; hypochile very broad at base, square, with a small rounded lobe at each basal outer corner, separated from the epichile by an impressed semi-circular curve with the convexity outwards; calli on epichile 3, parallel and close together, the central one triangular in section, high, gradually increasing in height forwards to beyond the middle of its length, then suddenly decreasing to end in the little point separating the endlobes, the lateral calli very much lower, roundly convex in transverse section, slightly higher in centre of their course; endlobes 1.5-3 mm. long. Colour of lip: Apple-green, the calli darker, endlobes very dark purple, hypochile dark purple except its margins which are increasingly apple-green from base forwards, underside apple-green with half its length in centre dark purple-red. Column opaque white, short, semi-circular in transverse section, the front completely hollowed and containing the stigmatic surface, the top slightly concave, the semi-elliptical gland with its 2 sessile anther-lobes separate one from the other but touching, occupying about $\frac{1}{2}$ of the area from front backwards and sideways; length of column about 5 mm., breadth 4 mm. Pollen-masses ovoid, 1 mm. long by less in breadth. Anther-cap squarish with round corners, broadest in front, convex, divided into 2 by a depressed central line, separating the 2 chambers which underneath are partially covered by a membrane; cap white slightly sprinkled purple. Length of twisted ovary 2.2 cm. Capsule 3.5-4 cm. long, spindle-shaped, slightly ridged, rising at an angle of 45°.

This species is a very distinct one. On account of the great size of the flowers and the characteristic shape of the various flower-parts, it cannot easily be confounded with any other species of the genus.

It comes nearest to *L. tenuifolia* but the following points distinguish our species at once: The leaves are not rounded at the apex, but conical-apiculate; the flowers are much larger in all their parts; the sepals resemble each other, all are boat-shaped and the apex is submarginate-apiculate; the lip is not narrowly pandurate but broadly oblong.

Locality: *N. Kanara*: In forests (T. R. Bell 5397, 5400, type, 5414, cotype); Yellapur (T. R. Bell 5398); Anmod, on *Zizyphus*, alt. 2,000 ft. (Sedgwick 3224!).—We made also use of a coloured plate by Miss E. Bell and MS. notes by T. R. Bell.

Flowers: Nov. 1919 (Yellapur); Dec. 1907 (Anmod).

Note: The plants are not easy to see owing to the leaves looking like stems or twigs and the flower, being always bent with its face to the stem, is most inconspicuous by reason of the green and red colouring.

6. *Luisia Evangelinæ* sp. nov. Blatter & McCann.

[*Orchidacea similis Luisiæ tenuifoliæ, differt tamen foliis apice longe caudatis, sepalis lateralibus subfalcatis, dorsali in dorso subcarinato.*]

Description: Stem long, slender, olive-green above with dark red-brownish spots and blotches. Roots very stout, vermiform, fleshy. Leaves up to 18 cm. long, 1-2 mm. in width, long-tailed at apex, tail about 2 cm. long and more or less jointed to rest of leaf, and projecting in a different plane. Buds seen from side triangular, the dorsal sepal flat and convex, broader than the 2 lateral mucronate ones which are keeled in the line of junction and rather prominently winged where they meet the dorsal one. Pedicel half as long as the bud, springing from a short woody support out of a short rounded brown bract; if several arise from one support, the support is just above a leaf, but not necessarily on the opposite side of the stem; base of bud suddenly narrowed into the ovary. Flowers very few, 18 mm. long, 20 mm. broad. Lateral sepals boat-shaped, slightly falcate, 8 by 3 mm. greenish, base red-brown. Dorsal sepal slightly longer, dorsally slightly keeled, obtuse at apex, greenish, base red-brown, spotted with red-brown on back. Petals longer than sepals, narrow, 15 by 1.5 mm.; rounded at apex, upper half apple-green inside, becoming purple towards the base, outside light purplish. Lip panduriform, about 13 mm. long, broad and square at base with 2 small rounded lobes; epichile decreasing in width towards apex, constricted in a wide curve to broaden out again into 2 diverging up-turned lobes 1.5 mm. long; disk with 3 calli, one central rather broad, triangular in transverse section, highest in middle, having its origin at commencement of epichile, running to and between the lobes, the lateral, one on each side, immediately contiguous, somewhat broad, but of uniform height more or less throughout, only on epichile; hypochile smooth;

flat. Colour of lip : white with a decided green tinge, hypochile dark purple in the middle throughout its length, each basal lobe with a central dark purple spot; the epichile sometimes with a chevron-shaped mark (the hollow side inwards), this chevron being sometimes reduced to a spot; the purple mark of the hypochile thinly prolonged on each side, sometimes up to the chevron which is however, always separate, each prolongation sometimes reduced to a spot; the epichile is separated from the hypochile by a semi-circular slightly impressed curve, the purple marking of the hypochile bordered irregularly towards the epichile. Column very short, semi elliptical in transverse section, the truncation being the front, slightly broader at top. Pollinia 2, ovoid, sessile, divergent from contiguous bases; gland large, deep purple-coloured; cap nearly pure white, the same shape as in *L. tenuifolia*. Capsule spindle-shaped, stalked, ridged, suberect.

Locality : N. Kanara : Astoli and Chandwadi (T. R. Bell, MS. and painting by Miss Evangeline Bell).

Flowers : April 1911.

23. COTTONIA Wight (Cke. ii, 702).

Species 2.—Ceylon to China.

We retain the one species given by Cooke :

1. *Cottonia macrostachya* Wight. Ic. v, pt. 1 (1852) 21, t. 1755; Dalz. & Gibs. Bomb. Fl. 263; Bot. Mag. t. 7099; Hook f. F.B.I. vi, 26; Trim. Fl. Ceyl. iv, 203; Cke. ii, 702; Fischer Fl. Madras, pt. viii, (1928) 1439.

Description : Cke. l. c.

Locality : Konkan (Stocks, Dalzell 4).—N. Kanara : Supa (Ritchie 1424.) ; Yellapur, 2,000 ft. (Sedgwick 2494 bis !); Astoli (T. R. Bell !); without locality (T. R. Bell 6062 bis !).

Flowers : May 1911 (Astoli) ; May 1917 (Yellapur) ; June 1919 (N. Kanara).

Fruit : May 1911 (Astoli) ; May 1917 (Yellapur).

Distribution : Konkan, N. Kanara, Malabar, Anamalais at 2,000 ft., Travancore, Ceylon.

24. VANDA R. Br. (Cke. ii, 703).

Species about 45.—Tropics and subtropics.

Cooke has 2 species : *V. parviflora* Lindl. and *V. Roxburghii* R. Br. ; the latter name has to be changed into *V. tessellata* Hook.

1. *Vanda parviflora* Lindl. in Bot. Reg. xxx (1844) Misc. 45; Wight Ic. t. 1669; Hook. f. F. B. I. vi, 50; Trim. Fl. Ceyl. iv, 192; King & Pantl. in Ann. Roy. Bot. Gard. Calc. viii (1898) 215, t. 286; Prain Beng. Pl. 1021; Cke. ii, 703; Haines Bot. Bih. & Or. 1181; Brühl Sikkim Orchid. 129; Fischer Fl. Madras pt. viii; (1928) 1444.—*Aerides Wightianum* Lindl. in Wall. Cat. 7320; Dalz. & Gibs. Bomb. Fl. 265; Wight Ic. v, pt. i (1852) 8.

Locality : Add : S. M. Country : Devicop, Dharwar Dist. 1,800 ft. (Sedgwick 5927 !).—N. Kanara : Yellapur (Sedgwick 2478 !); Wadchukli (T. R. Bell !).

Flowers : May 1887 (Poona, cult.); May 1817 (Yellapur); May 1911 (Wadchukli).

Fruit : April 1919 (Devicop) ; May 1917 (Yellapur) ; May 1911 (Wadchukli).

Distribution : Kumaon, Nepal, Sikkim, Assam, Burma, Chota Nagpur, Konkan, W. Ghats, S. M. Country, N. Kanara, in all districts of Madras Pres. in hilly tracts, 1000–4,000 ft.

2. *Vanda tessellata* Hook. ex G. Don in Lond. Hort. Brit. 372; Fischer Fl. Madras pt. viii (1928) 1445; Haines Bot. Bih. & Or. 1181.—*Epidendrum tessellatum* Roxb. Corom. Pl. t. 42.—*Cymbidium tessellatum* Swartz in Nov. Act. Upsal. vi, 75; Roxb. Fl. Ind. iii (1832) 463.—*C. tesselloides* Roxb. Fl. Ind. l.c.—*Aerides tessellatum* Wight in Wall Cat. 7318.—*Vanda tesselloides* Reichb. f. Walp. Ann. vi, 864.—*V. Roxburghii* R. Br. in Bot. Reg. vi (1820) t. 506; Wight Ic. t. 916; Hook. f. F. B. I. vi. 52; Trim. Fl. Ceyl. iv, 192; Duthie Ann. Roy. Bot. Gard. Calc. ix, t. 116; Prain Beng. Pl. 1021; Cke. ii, 704.

Locality : Gujarat : Chikli (Gibson).—Konkan (Woodrow !).—N. Kanara : Kalanuddi (Ritchie 1425) ; Astoli (Bell !); in forests (Bell 5399 !).

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Flowers : April 1911 (Astoli).

Fruit : April 1911 (Astoli).

Distribution : Forests of Dehra Dun and in the sub-Himalayan tracts of Rohilkhand and N. Oudh, Bengal, Bihar, Chota Nagpur, Central Prov., Gujarat, Konkan, N. Kanara, in all districts of Madras Pres., about sea-level to 2,000 ft., Travancore, Ceylon.

25. DIPLOCENTRUM Lindl. (Cke. ii, 704).

Species 2.—India.

1. *Diplocentrum congestum* Wight Ic. v, pt. 1 (1852) 10, t. 1682; Hook. f. F.B.I. vi, 78; Rolfe in Hook. Ic. Pl. xxvii (1901) t. 2687; Cke. ii, 704; Fischer Fl. Madras, pt. viii (1828) 1449.

Locality : W. Ghats : Castle Rock (T. R. Bell 7505!).—N. Kanara : Sirsi-Kumpta road (Woodrow!).

Flowers and fruit : May 1920 (Castle Rock).

Distribution : N. Kanara, W. Ghats of Bombay and Madras Pres., Travancore.

26. ACAMPE Lindl. (Cke. ii, 705).

Species about 15.—East Africa, Madagascar, India, Malacca, China.

There is only one species in Cooke : *A. Wightiana* Lindl. We change its name into *A. præmorsa*.

1. *Acampe præmorsa* nov. comb. Blatter & McCann.—*Epidendrum præmorsum* Roxb. Corom. Pl. t. 43.—*Cymbidium præmorsum* Swartz in Nov. Act. Upsal. vi, 75; Roxb. Fl. Ind. iii (1832) 465.—*Aerides præmorsum* Grah. Cat. 204 (non Willd.).—*Saccolabium præmorsum* Hook. f. F.B.I. vi (1890) 62; Prain Beng. Pl. 1022; Haines Bot. Bih. & Or. 1180.—*Acampe Wightiana* Lindl. Fol. Orchid. (1853) 2; Cke. ii, 705; Fischer Fl. Madras, pt. viii (1828) 1447.—*A. excavata* Lindl. Fol. Orchid. l. c. 3.—*Saccolabium Wightianum* Hook. f. F. B. I. vi (1890) 62; Trim. Fl. Ceyl. iv, 199; Petch in Ann. Roy. Bot. Gard. Peradeniya 7 (1920) 79-83.—*Vanda Wightiana* Lindl. ex Wight Ic. v, pt. 1 (1852) 9, t. 1670.—*Saccolabium papillosum* Dalz. & Gibs. Bom. Fl. (1861) 264 (non Lindl.).

Description : Cke. ii, 705.

Locality : Konkan : Kanheri, Thana Dist. (Gamme 16273!); Thana Dist. (Ryan 5! Herb. Calc.); Bhandup (Blatter 25820!); Condita, Salsette (Blatter 25816!); Sion (Blatter 15371!); Indapur (Graham).—S. M. Country: Belgaum (Ritchie 716); Devicop (Sedgwick 4084!).—N. Kanara : Dandeli (Sedgwick 2546!); in forests (Bell 5398!).

Flowers : May.

Fruit : July.

Distribution : Bengal, Chota Nagpur, Bombay Pres., W. Ghats of Madras Pres., Circars, Godavari Dist., Ceylon.

27. SARCANTHUS Lindl. (Cke. ii, 706).

Species about 90.—Ceylon, India to New Guinea.

Only one species from the Presidency, *S. peninsularis* (called by Cooke *peduncularis* by mistake).

1. *Sarcanthus peninsularis* Dalz. in Hook. Kew Journ. Bot. iii (1851) 343; Dalz & Gibs. Bomb. Fl. 264; Hook. f. F.B.I. vi, 67; Trim. Fl. Ceyl. iv, 200; Fischer Fl. Madras, pt. viii (1928) 1447; Rolfe in Kew Bull. (1914) 71.—*S. pauciflorus* Wight Ic. (1852) t. 1747.—*Saccolabium acuminatum* Thw. Enum. Pl. Ceyl. (1861) 304.

Description : Cke. ii, 706.

Locality : Konkan : (Stocks 35); Wari country (Dalzell).—N. Kanara : Kalanaddi (Ritchie 430); Arbail Ghat, 1,550 ft. (Sedgwick 5836 bis!); Yellapur, 1,500 ft. (T. R. Bell 7870!); Anshi (T. R. Bell!).

Flowers : May (Anshi).

Fruit : Aug. 1919 (Arbail Ghat).

Distribution : Konkan, N. Kanara, W. Ghats of Madras Pres., Travancore, Ceylon.

(To be continued.)

A FEW NOTES ON PERSIAN, AFRICAN AND
INDIAN LIONS IN THE FIRST CENTURY AFTER CHRIST.

*Read on Wednesday the 15th July, 1931 before the
Bombay Natural History Society.*

BY

DR. SIR JIVANJI JAMSHEDJI MODI, KT. B.A., PH.D., C.I.E., LL.D.

I

INTRODUCTION.

The subject of this Paper is suggested by an interesting article, entitled 'The Lions of Asia' by Mr. R. I. Pocock, in a recent issue of the *Journal of the Bombay Natural History Society* (vol. xxxiv, No. 3, pp. 638 ff.). It is the general account of the lions, and not the too technical, that has interested me. The object of this brief paper is two-fold :

- (1) To submit a few observations on the subject of the lions from an old Iranian or Persian point of view.
- (2) To submit a few notes on the lions of Persia, Africa and India, as collected from an account of the travels of a Greek ascetic or *sâdhû*, Apollonius of Tyana, as given by Philostratus the Elder, on the authority of the Notes of Damis, a disciple of Apollonius, who accompanied the Greek *sâdhû* in his travels in the countries of the Iranian Magi and the Indian Brahmins. In these few Notes, as regards my account of the observations of Apollonius, I follow a recent publication of the biography of Apollonius, entitled, 'Life and Times of Apollonius of Tyana, rendered into English from the Greek of Philostratus the Elder', by Charles P. Eells (1923). I will, at first, say a few words on Apollonius and his travels.

II

APOLLONIUS OF TYANA.

Apollonius, who is said to have lived for 100 years, was born about three years before Christ in Tyana, a city of the Greeks which was the capital of Cappadocia in Asia Minor. He was a follower of the philosophy of Pythagoras (d. 500 B.C.), who himself was said to have been a disciple of Zoroaster, i.e., a follower, to some extent, of the teachings of Zoroaster.¹ From his very boyhood, he devoted himself to the study of philosophy and practised austerities. He is

¹ Pythagoras and the Delphian Mysteries, by Ed. Schure, translated by F. Ruthwell (1918), p. 27.

said to have observed complete silence for five years in order to discipline his mind. Like Gautama Buddha of India, he distributed his patrimony among the poor, abstained from the company of women, observed vegetarianism and total abstinence from wine. He is said to have predicted future events, read the minds of men, and known what happened in foreign lands. Like the ancient Iranians and like some of their descendants, the modern Parsees, he prayed to God, reverencing the Sun thrice a day, offering incense to the deities, who, he believed, were 'merely phases and agencies of the Supreme Deity.' Like Iarchus, the Indian sage, with whom he had long interviews, he compared the universe to a ship, God to its captain and the subordinate deities to the subordinate officers under the captain. He believed in metempsychosis. He travelled a good deal from the Atlantic in the west *via* Persia, to the Ganges in the East, returning to his country, *via* the Persian Gulf and Babylon. He went to the south in Egypt up to the Cataracts of the River Nile. He is said to have worked some miracles like Christ and some Indian Brahmins. He was honoured as a god after his death, and, to some extent, even in his life. After his death, the Emperor Hadrian founded at Tyana a temple in his honour and instituted a special class of priests for worship in that temple. Alexander Severus, another Roman Emperor, is said to have installed in his 'private chapel or *lararium*' his image, 'in company with Orpheus, Abraham and Christ'.¹ It was Juslia Domna, the queen of the Emperor Septimius Severus, who deputed Philostratus to write a life of Apollonius on the authority of the Notes of Damis, spoken of as 'the Asiatic Boswell of Apollonius'², that were preserved, and on that of some other materials which she had collected. Sometime after this, Hierocles, a Roman pro-consul of the Emperor Diocletian, in his book *Candid Words to Christians*, in order to set back 'the rising tide of Christianity and in his zeal of comparing and extolling him, showed Apollonius in a better light than Christ.' The followers of the nascent Church, thereupon, began turning the tide upon the fame of Apollonius and represented him as a charlatan, sorcerer, etc. This turning of the tide seems to have continued since, especially with the advancement of new learning.

Some of the feats, attributed to Apollonius, remind us of the feats of some eastern adepts, e.g. Āzar Kaivān of Istakhar or Persepolis in Persia, who also is said to have travelled to India, in the time of Akbar with a number of disciples and stayed in Patna, the seat of pilgrimage of Buddhist, Brahmin and Jain devotees.

III

THE LION IN OLD PERSIAN LITERATURE.

Mr. Pocock says: 'It is a matter of common knowledge that within historic times the lion extended, so far as Europe and Asia are concerned, from northern Greece and Macedonia to western

¹ Life and Times of Apollonius *op. cit.*, Preface p. 4.

² *Ibid.*, p. 6.

Bengal. In Europe, Asia Minor and Syria it has long been extinct.' (p. 641). This statement has led me to look into old Persian books, to know what is said about lions in those books.

Lion not mentioned in the Avesta Books

Looking to the older Iranian writings of the Avesta, we find mention made of ferocious beings like the wolf and snakes, but no mention is made of lions and tigers. So, we may safely say, that lions and tigers were not found in the countries where the Avesta was written. There is a difference of opinion as to the Home of the Avesta, i.e., as to where the Avesta was written. Scholars like Dr. Spiegel, Prof. Harlez and Dr. Dillon¹ said that the Avesta was (a) co-Achæmenian or post-Achæmenian and (b) that its Home was in the West in or towards Media. On the other hand, Prof. Geiger and other Oriental scholars say that the Avesta was pre-Achæmenian and pre-Median, and that its home was in the East towards Bactria, and not in the West towards Media. Most of them say that the Home of Zoroaster was in the West towards Media, but that he promulgated his religion and wrote the Avesta in Bactria.

Thus, as the Home of the Avesta was in the east of Persia, in Bactria, and as we find no mention of the lion in the Avesta, we are led to think that the lion did not flourish there. The Home of the Pahlavi writings was west-ward. So, when we find a reference to the lion in Pahlavi books written in a comparatively western part of ancient Persia, we are led to think that the lion flourished there, i.e., in the western part of the Persian Empire, e.g., in Mesopotamia.

Mr. Pocock's Association of the Lion with Tigers and Panthers. The same in a Pahlavi Book.

Mr. Pocock associates the lions with tigers and panthers in one genus, the genus *Panthera* and speaks of the three as 'these great Cats'.² When we look to a very earlier Pahlavi book, the Bundelesh (the origin *bûn* of Creation, *dehesh*, the Iranian Genesis), we find there some account of the fauna and flora of ancient Persia, but therein we do not find any mention of the lion. This book has its origin in a lost Avesta book, known as the Dâmdâd nusk³. So, as the lion was not known in the country where Avesta was written, i.e., in and about Bactria, we do not find any mention of the lion in this old Pahlavi book also, because it was based on a lost Avesta book. But we find⁴ the lion referred to in some later Pahlavi books.⁵

(a) Firstly, it is mentioned in the later Bundelesh, known as the Greater Bundelesh, which, as I have shown in my Bundelesh,⁶ is a

¹ *The Home and Age of the Avesta* translated from the German by Mr. T. H. Walsh, Bombay, 1887.

² *Jour. Nat. His. Society*, op. cit., p. 638.

³ Vide my Transliteration and Translation of the Bundelesh, p. 10.

⁴ I am indebted to Mr. Bomanji N. Dhabhar for some of these references.

⁵ The Bundahishn, edited by the late Ervad Tehmuras Dinshaji Anklesaria (1908), p. 147, l. 13.

⁶ *Ibid*, pp. 19 ff.

later amplification of the original old Bundelesh. There we read that the tiger, the lion and the panther are mentioned in the class of wolves. We read : '*Ākhar avârik gûrg sardagân chegûn baparg va shêr va palang*.' i. e. 'The other kinds of wolf like the tiger,' the lion² and the leopard.³

We find from this passage that, like Mr. Pocock, the writer of this later Bundelesh associates the tiger, the lion and the leopard in one group and he speaks of them, as it were, as 'the great Wolves.'

(b) *Lion in the Pahlavi Shikand Gumanik Vijâr.*

The lion is referred to in the Shikand Gumanik Vijâr as a ferocious animal from whom a man is to be afraid. In this respect, he is classed⁴ with wolves, (ferocious) dogs, and robbers (*shîr va gurgân va kalban va dûydan*). The lion is referred to again in this book as killing men at times and as being killed by men at other times.⁵ '*Āigham khaditûnt mardî mînash sher i âyûp sheri munash mardî bara zaktalunt*,' i.e., 'I saw a man whom a lion killed or a lion whom a man killed.'

Lion referred to in a Pahlavi Pand-nameh.

We find a reference to the lion in the Pahlavi 'Pand-nameh-i-Adarbad Maraspand' i.e. the *Book of Advice* by Adarbad Maraspand who was a divine of the reign of Hormuz Shapur, the grandson of Ardashir Babegan. There we read : '*Dayan abû va am i nephshman tarskâs va niyokshidâr va farmân-bardâr yehvûnît meman gabrâ vad abû va am i zivandeh avin humanâk chegûn shîr amat dayan visheh min âîshîch sîah la tarcel*' i.e. 'Be respectful, careful to hear and obedient to your father and mother, because a man during the life time of his father and mother is like a lion that is afraid of none in a forest.' Here we find a reference to a lion as the bravest of all animals.

Derivation of the word 'Shir'

The Pahlavi and Persian word '*Shir*' for lion is derived by Darmesteter from Avesta *khshathrya*, king (cf. Pahl. Artakhshathra, Pers. Ardashir)⁶. Darmesteter gives this derivation, while giving an account of the process of epenthesis, but does not explain the word. The lion is said to be the king of animals. Hence, this derivation. This derivation is supported by what we read in '*Pythagoras and the Delphian Mysteries*, by Ed. Schurè.' We read : 'In their

¹ P. ببر or بمان babr or babr-i biyân.

² P. شہر shêr.

³ P. پلنگ palang.

⁴ Chap. iii, 34, 37 S. B. E., vol. xxiv, p. 127. The text of Drs. Hoshang and West (1887), p. 193, l. 7.

⁵ *Ibid.* chap. v, 32, Text, p. 209, l. 7.

⁶ *Études Iranniennes*, vol. I, p. 106.

⁷ Ed. Schurè's work Translated by F. Rathwell (1918), p. 27.

temples darkness reigned in broad daylight. Lamps were lit without human agency. The Magi gave the name of celestial lion to this incorporeal fire, the agent that generates electricity which they could condense or disperse at will.' We know, that Parsee writings speak of the sacred fire of the Fire-temple as *shâh* or king. As a king rules over, and protects, a country or city, so, the Sacred Fire of a Temple rules spiritually over a country or city where it is situated and protects it. This sacred fire which is spoken of as a king was, as told by this author, called 'celestial lion.' Hence the derivation of the word *shîr* (lion) from *khshathrya*, king, seems to be probable.

IV

THE LION REFERRED TO IN THE ACCOUNT OF APOLLONIUS'S TRAVELS IN PERSIA.

Now, I will speak of what is said of the lion in Philostratus's account of Apollonius's travels in Persia and India.

Lions in Mesopotamia, the Western part of the Persian Empire

Mesopotamia formed a part of the Persian Empire at the time when Apollonius passed through it towards India. We read about his travels in this region, that, after passing Ctesiphon and entering the territory of Babylon, he met the Persian King Verdanés.¹ In the account of Apollonius's approach before Verdanés, we read : 'About twenty stadia further on, they came upon the largest lioness they had ever seen, which had just been killed by a party of hunters from a nearby village, who were shouting over it as a great curiosity. It certainly proved to be so, for when ripped open it was found to contain eight cubs. Now the normal period of gestation in lionesses is six months, and each lioness produces only three litters in her life, having three cubs in the first litter, two in the second and only one cub in the third, which is said to be unusually large and fierce. No credence should be given to the fable that young lions gnaw their way out of the womb through their mother's body, for the natural instinct to preserve the race is common to all parents and their offspring.' After silently observing the beast for some time, Apollonius said to Damis : 'We shall spend one year and eight months of our pilgrimage with the king of this country, for he will not let us go sooner ; and besides it will be for our advantage to make that stay. The cubs stand for the eight months and the lioness for the year as perfect things are to be compared with perfect.'² The

¹ This Verdanés was the Parthian King, known in his country as Behram Goudarz. This Gudurz is the Gutarzes of Western writers. He was the third king of the second Arsacide dynasty. He is said to have punished the Israelites for having killed John the Baptist (Malcolm's *History of Persia*, vol. i, p. 66). Vide *Encyclopædia Brit.*, 9th ed., vol. xviii, p. 601.

² Life of Apollonius, op. cit., p. 22.

stay of Apollonius in the court of the Persian king, lasted 18 months as predicted by Apollonius.

We gather the following facts about the lion from Philostratus's account of Apollonius's visit of Mesopotamia:

1. An extraordinary big lioness had eight cubs in her womb.
2. The normal period of gestation in lionesses is six months.
3. Each lioness produces only 3 litters in her life. She has three cubs in the first litter, two in the second and one in the third. This last one is unusually large and fierce.
4. There was a belief at the time that young lions gnawed their way out of the womb through their mother's body. But that was a wrong belief.
5. People took some predictions from animals like the lions.

An Iranian King's Hunt of Lions at Babylon.

From Apollonius's account of the Iranian king's hunt at Babylon, we gather the following:

(a) The Iranian kings had a preserve at Babylon where lions, bears and leopards were kept for their hunt.

(b) The king used beaters who harassed the beasts, and fenced them in 'so that they cannot protect themselves in their own way.'¹ We learn from this statement that the modern Indian practice of kings (a) to have their own preserves and (b) to take the help of beaters in the hunt, is very old, more than about 2,000 years old. As to what is said about harassing the lions, etc., and forcing them into an enclosed fence and then hunting them, that does not seem to be now practised in India. I had the pleasure of seeing in December 1924, through the courtesy of the present Maharaja of Oodepur—'the Kashmir of Rajputana'—who was then a prince, a tiger-hunt and I saw that there was no forcing the animals within a fence.

Lions in the country round Taxala, in the Eastern part of the Persian Empire.

At the time of Apollonius's visit to India, Taxala and the country round about it formed the eastern part of the Persian Empire. It was ruled over by Phraotes², a Parthian king. Apollonius had an interview with that king and he speaks thus about the order of Phraotes to his lion-tamers: 'They must never strike the lions, because lions once beaten never forget the injury; nor must they pat them, because they would become spoiled; but they could make them docile by stroking them softly and showing the whip at the same time.' Apollonius thought this instruction about curbing the lion to be equally useful for curbing tyrants.³ In this connection, we find a reference to Æsop's lion. Damis says to Apollonius: 'Æsop tells of another lion, in a den, who, he says, was not really ill though he pretended to be, and who used to pounce on any beasts which came to see him.'

¹ *Ibid.* Bk. i, 38. Life of Apollonius op. cit., p. 33.

² This Phraotes seems to be Phraotes V (Vide *Encyclopædia Britannica*, 9th ed., vol. 18, p. 600, col. 2.)

³ Bk. vii, 30. The Life of Apollonius, op. cit., p. 204.

V.

AFRICAN LIONS.

We find two references to the lions of Africa: (a) A reference to the lions of Egypt and (b) A reference to the lions of Ethiopia (modern Abyssinia).

The Story of an African Lion: Its Metempsychosis.

In this account of Apollonius's visit, we find the story of an African lion associated with the belief in metempsychosis. We read: 'A beggar was leading a lion about in a leash like a dog,'¹ which fawned on its master and on any one else who came near. They begged their way about the towns, and even went into the temples, as the animal was pure and did not lick up the blood of victims, nor try to get at their skinned and cut up carcasses, contenting himself with honey-cakes, and rolls, and sweetmeats and cooked flesh. He would even drink wine at times, without being affected by it. Apollonius being seated in a temple, this lion came up to him and gently rubbed against his knees, soliciting him alone, of all the men there'.¹ Some thought that he was begging money, but Apollonius said, 'He is begging me to tell you whose soul he has. He was that Amasis who was a king of Egypt in the Saitic Province. On hearing that, the lion howled mournfully and groaned pitifully, crouching and actually shedding tears.' Then Apollonius said, patting him: 'I think this lion should be sent to Leontopolis and be kept in the temple there. I do not think it right that a king, who has been metamorphosed into an especially royal beast, should wander about as a beggar. Thereupon the assembled priests made sacrifice for Amasis and sent the animal into Egypt adorned with a collar and fillets, while they played on flutes and chanted hymns and songs about him.'²

Lions of Ethiopia.

We read the following about Ethiopian lions in the life of Apollonius: 'They saw lions and leopards and beasts of that description near the trail, which did not molest the party, but got out of their way as if afraid of man. They also saw deer, gazelles, ostriches, zebras in great numbers, and still more numerous wild cattle (buffaloes?) and ox-goats (gnus?). Of these animals the wild cattle are a combination of the bull and the stag; and the ox-goats are a compound of the animals whose names they bear. The party often came across bones of these beasts, and their half-eaten carcasses; for lions, after gorging themselves with a recent kill, would abandon the remnants, trusting to the success of their next hunt, as I suppose.'³

VI.

LIONS IN INDIA.

We find several references to Indian lions in Philostratus's account of Apollonius's visit of India.

¹ We observe even now, practices of this kind in India, wherein beggars lead about animals like a cow, a goat, a bear, etc., and ask for alms.

² *Ibid.*, Bk. v, 42, p. 146.

³ Bk. vi, 24. Life of Apollonius, op. cit., p. 172.

Lions abounding in India.

From the account of the return of Apollonius from India, where he lived for about four months in a hill-town, we learn, that on approaching the Erythraean Sea,¹ he passed through a country abounding with 'many ostriches and buffaloes, many asses and lions and leopards and tigers, and a different kind of ape from those found in the pepper-trees, these being black and bristly, shaped like a dog and about as large as a small man.'²

(a) *Lions and Apes as enemies in India.*
Indians protect Apes.

In the account of Apollonius's visit to India, we find a curious instance of how apes help men, and so, are helped in return by men against lions. In one mountainous place there grew pepper-trees in abundance 'in precipitous rocks inaccessible to men.' The apes thus helped men in collecting pepper from the trees on these inaccessible cliffs. 'The native method of procuring the pepper is to gather the berries from the few trees which grow below the cliffs, wherever they can be reached, and then to clean a space about each tree, on which they fling the berries down as if getting rid of a useless thing to which they attach no value. Meantime the apes are watching these proceedings from the inaccessible cliffs, and when night comes they imitate these actions of the natives by plucking the berries from their own pepper-trees in high glee and throwing them down on the places cleared by the men. Next day the Indians come and take away those piles of spices, which have been gathered without any labour of their own, while they were asleep at their ease.'³

Now, Philostratus, the biographer of Apollonius, says that the lions in this part of the country⁴ killed the apes for their food. So, the natives defended the apes 'from lions with dogs and weapons'⁵ and killed the lions.

(b) *Lionesses breeding with Leopards.*

Mr. Pocock, in his above-mentioned article, thus speaks about spotted lions: 'It is well-known that newly-born lion cubs are not uniformly tawny in hue like the adults; and it was stated by Lydekker (*Game Animals of India*, p. 293, 1924) that their spotted pattern proves the descent of the lion from a spotted progenitor, like the panther. Unfortunately for this theory lion cubs are by no means always spotted.'⁶ Then, referring to a certain lion cub Mr. Pocock says: 'If we take this cub as a criterion, it appears to supply evidence that the ancestor of the lion in the matter of pattern stood midway between the panther and jagaur on the one hand and the tiger on the other; and this pattern is strong corroborative

¹ 'The whole expanse of sea between Arabia and Africa.'

² *Ibid*, Bk. iii, 50, p. 89.

³ *Ibid*, Bk. iii, 4, pp. 35-66.

⁴ The country is spoken of as 'the range of the Caucasus which extends towards the Erythraean Seas.' This seems to be the Hindukoosh.

⁵ *Ibid*, Bk. iii, 4, p. 65.

⁶ *Jour. Nat. His. Society*, vol. xxxiv, No. 3, p. 639.

testimony of the close kinship between lions, tigers and panthers.¹ This view, that, in some cases, lion cubs are the offspring of the lionesses' union with tigers, is supported by what we read in the account of Apollonius's, visit to India: 'It is said of lionesses that they accept leopards, as their lovers, and entertain them in the lions' lairs in the plains'², (b) that 'when their pregnancy (by the leopards) is nearly over they run away to the hills where the leopards range'³, (c) that 'the cubs they bring forth are spotted like their sires (i.e. the leopards)'⁴, and (d) that 'for that reason the lionesses hide them from the lions and suckle them in distant thickets, pretending to go there to hunt by themselves; for any such cubs which the lions discover they tear to pieces as bastards.'⁵ Apollonius, in his conversation with Damis, refers to one of Homer's lions, which 'glares fiercely about and nerves himself to fight for his litter of cubs.'⁶

*Flesh of Lion eaten by Indians.*⁷

When Apollonius came to a region between the Caucasus and the Kophen river, he came across a people who ate the flesh of lions. We read: The nomads 'raised a joyful shout and called them nearer, and on their approach held out to them a wine which they make very skilfully from dates, and honey obtained from the same trees, together with slices of lion and leopard meat which had just been skinned.'⁸ We read further on that, at times, lions were cooked and 'served up whole.'⁹ The account of the feasting of the eastern Iranians on lions, etc., is interesting, and so, I will quote it at some length: 'The king reclines on a couch, and near him recline not more than five of his kindred, but all the other guests sit during the meal. A circular table is set in the midst, which is about knee-high, like an altar, of a size which thirty men could encircle by taking hands like a chorus. On this table are scattered laurel leaves, and another leaf like myrtle, which the Indians use as perfume. Fish and fowl are set on it, with lions, antelopes and swine, served up whole: but only the hind quarters of tigers, for they are unwilling to eat the rest of that animal, because they say that as soon as it is born, it lifts its fore-paws to the rising sun. Each guest rising in turn goes from his seat to the table and selects or carves for himself his portion of the dishes set on it, which he brings back to his place and eats there,¹⁰ accompanying it with a great deal of bread. When all have enough to eat, gold and silver bowls are passed around to them, one for every ten guests, from which they drink, stooping their heads to it like sheep at a trough.'¹¹

¹ *Ibid.*

² *Ibid.* Bk. ii, 14, p. 45.

³ *Ibid.*

⁴ *Ibid.*

⁵ *Ibid.*

⁶ *Ibid.*

⁷ The India, referred to by Damis in his account of Apollonius, on which the life of Apollonius as given by Philostratus depends, began from a region on the west of modern India. The mountainous region on the west of India was known as the Caucasus. This western region had Taxala as its capital and it was ruled over by an Iranian King, Phraotes, who was a Parthian.

⁸ *Ibid.* Bk. iii, 6.

⁹ *Ibid.* vol. ii, 28.

¹⁰ I remember attending some such dinners at Sweden when I went to Stockholm in 1889. There also the guests serve themselves.

¹¹ *Ibid.* Bk. ii, 28, pp. 53-54. If the Parthians were Zoroastrian, this custom of drinking from the same cup looks strange as it is non-Zoroastrian.

THE VERNAY SCIENTIFIC SURVEY OF THE
EASTERN GHATS
(ORNITHOLOGICAL SECTION).

BY

HUGH WHISTLER, F.Z.S., M.B.O.U., ASSISTED BY N. B. KINNEAR,
M.B.O.U.

(With two maps and one text-figure.)

In the *Journal* for July 1930 (vol. xxxiv, pp. 386-403), we furnished an introductory account of the genesis of the Vernay Survey of the Eastern Ghats and the work which it was expected to accomplish. The introduction was then followed by a preliminary report on the first collection which was sent in by Mr. LaPersonne from the Salem district. Since that report was written, the work of the Survey in the field has been completed, and the whole collection has been received at the British Museum.

The speed with which the specimens from the various collecting camps reached England and the paucity of field-notes from some of the camps, have led us to abandon the idea of reporting separately on the birds from each locality. It was found that this would lead to a good deal of reduplication of work. Single birds would take as much time to identify as complete series. Whilst in those cases where revision of a species or group was required, it would be sheer waste of time to write out in detail the results of an examination, whose value and results might be affected by material received in a subsequent batch.

No further local report has therefore been written. In the meantime, however, much work has been put in on the collections. We now propose to start the publication, in batches, of the result of our examinations of the collection as a whole.

It will, however, be desirable to explain, first of all, the manner in which we propose to deal with our material.

After a good deal of consideration, we have decided to deal with the survey material from two aspects, that of the Madras Presidency as a politically defined area, and from the general aspect of Indian Ornithology.

There can be no doubt that, ornithologically, the Madras Presidency is the least known part of India. It is not easy to understand why this should be so, but the fact remains. We think therefore it will be useful to write our report in the form of an account of the birds of the Madras Presidency, mentioning all species which have been recorded from the Presidency whether they have been met with by the Survey, or not. Under each species we shall detail briefly all that is recorded about it from within the Presidency limits. Our idea is that this account should bring to the notice of observers within the Presidency the points on which they can supplement published knowledge. The distribution of even the most common birds is imperfectly known, and if our account serves to underline this fact there will certainly be a response from local observers who alone can fill in the deficiencies.

Here a word of explanation is due. Since we started the preparation of this aspect of the report, Messrs. Inglis and H. R. Baker

have published a book on the *Birds of Southern India*, by which is meant virtually the Madras Presidency. We have had to consider, therefore, whether this book nullifies this aspect of our report. We do not however think so. The authors expressly state that their book is a compilation, and it consists mainly of extracts from the new edition of the *Fauna*. The distributions are written in general terms and express not so much what are known to occur as what may be expected to occur. The result is not very accurate as the differences between the widely different areas included in the Presidency are marked and not always easy to foresee. We have therefore continued our original design, and because, (as explained below), we have gone back to original records. We have not quoted from the book except in respect of those records which are clearly original and published for the first time. This will explain why our account of the distribution of species in the Madras Presidency does not always agree with those in this book.

With regard to those species actually obtained by the Survey, we have gone into far greater detail. We have sought to make the new specimens the vehicle for a revision of the species represented. To this end we have done a great deal of work which will never appear on paper.

The first thing has been to collect and collate all published records that we could find bearing on the species within British India proper, keeping as a rule to the boundaries of British India, but taking cognizance of any records from Baluchistan, Kashmir, Assam, Burma and Ceylon which might appear to be useful and pertinent. These records have been plotted out on skeleton maps of India, similar to those used in the *Mammal Survey*. These published records have further been supplemented by any records we have collected from private correspondence and from the examination of specimens.

When the known range of the species within British India has thus been accurately discovered we have set ourselves to revise the question of geographical races. To this end we have examined and measured a vast amount of material. The main body of our material has of course been furnished by the huge collections of the British Museum. These have, however, been turned over by numbers of workers in the past 50 years. Our hope of finding new results of value are based on the fact that we have supplemented the material in the British Museum not merely with the specimens procured by the Survey, but by the large amount of fresh material contained in Dr. C. B. Ticehurst's collection from Sind and the large collections made in 16 years' service in N.-W. India by one of the authors of this report. In addition we have examined many other specimens contained in the Society's own collection as well as valuable material kindly provided by Mr. H. W. Waite, Colonel R. Sparrow, Colonel R. Meinertzhagen, Mr. A. E. Jones, Rev. F. S. Briggs, Mr. C. M. Inglis, Mr. D'Abreu of the Central Museum, Nagpur, the Director of the Zoological Survey, Calcutta, and Dr. Gravelly of the Madras Museum. It will be a long time before so much material is again available, assembled for examination. We are obliged also to Dr. C. B. Ticehurst for reading through our manuscript and assisting us on many points.

In estimating the question of geographical races in India, we have somewhat departed from the customary method of procedure. This is to take the specimens from an established type locality as a basis, comparing all others with them as a starting point. This would be an excellent method if a type locality were originally fixed on scientific principles, so that one might deduce from it some fact such as the origin of the parent form. But it has seemed to us that the basis of the type locality, as at present established under the rules of priority in nomenclature, is necessarily haphazard and unscientific. To take the first species on our list for instance—the Jungle Crow—we find that Poona has been fixed as the type locality for the form *culminatus* on grounds of nothing more or less than historical accident. If the geographical races of the bird in India were negligible and science was merely concerned with the Jungle Crow as a species, a central type locality like this might be an advantage. But examining the races of the bird and finding marked differences in the bird at the three points of the Indian triangle, differences almost sufficient to separate three species if there were not connecting intermediate areas, we can only regard as unfortunate a type locality near the area, where all three races intergrade.

In our examination of every species, therefore, we have *at first* entirely disregarded published opinions and the established type localities of the Indian area. We have worked out the apparent Indian races with their distribution *de novo* and then to the result have applied the existing names and type localities. By this means we are able to recognize races which would not be *so* apparent by the method of comparing extremes, not with each other, but with an intermediate.

We are afraid that field-workers in India may not relish the fact that in many cases we have had to differ from the sub-species as recognized in the *New Fauna*. We are in sympathy with their feelings. Twenty years ago, working ornithologists in India were almost alone in the world in the happy possession of a uniform nomenclature, that of Blanford and Oates in the first edition of the *Fauna*. They worked to a uniform and neatly numbered catalogue. But it was at the cost of a static separation from the progress in ornithology in the rest of the world. The perfection of their happy separation has made their re-entry into world-currents the more difficult. European ornithologists have had a complete generation of gradual changes in which to accomplish the change to recognition of subspecies and the strict application of the laws of priority. Indian ornithologists have paid the penalty for compressing these changes into a dozen years, the usual penalties for haste. The *Handlist* upset the firmly established nomenclature of Blanford and Oates. Then the new *Fauna* upset the *Handlist*, and was again itself upset by its own volumes of synonymy and corrigenda. Now we fear that we shall propose a number of changes that will not agree even with the revised list in vols. vii and viii of the *New Fauna*.¹

¹ For the sake of brevity we propose to refer to the *Fauna of British India, Birds* by Blanford and Oates, 4 vols. 1889–1895 as the *Old Fauna* and to the *Fauna of British India, Birds*, second edition, by E. C. Stuart Baker, 8 vols. 1922–1930 as the *New Fauna*.

These changes will be found to fall into two categories. In some instances we are unable to agree with the names in the check-list of vols. vii and viii for reasons concerned with the ordinary application of the rules of nomenclature. In the majority of instances, however, the changes will be found due to the fact that we are unable to agree with the subspecies as defined in the *New Fauna*. This is partly due to the fact that we have examined more material than Mr. Stuart Baker, some of which was not available when he wrote. We have thereby been compelled sometimes to recognize races on differences which, to some, may seem small. But we consider that the study of races must be consistent. If the possession of a large beak is sufficient to separate *Parus major newtoni* of the British Isles from the continental form, the fact that *Microscelis psaroides* in Ceylon has a larger beak than in Peninsula India is also sufficient for the creation of a subspecies. The fact itself was recognized by Hume 50 years ago. It is useless recognizing the north-western and south-western races of *Pomatorhinus horsfieldii* and denying recognition to the other equally marked races. A small difference is just as important as a large difference provided that it is constant and is recognizable under the usual 75 per cent. rule.

One thing however Indian ornithologists must clearly recognize. Under the binomial system of the *Old Fauna*, clear-cut distributions were easy and possible. A species occurs or does not occur in an area and the only doubt on the point is the credibility of the evidence. Under the trinomial system it is seldom possible to define the ranges of the different subspecies in a continental area like India, because of the intergrading between the subspecies, which are generally easily distinguished at their further limits and grade inwards to a common centre. The worker at Cape Comorin and at Peshawar will have little difficulty in identifying his subspecies. The man in the Northern Central Provinces will, on the other hand, be able to be positive about very few races amongst the wide-spread species. This difficulty cannot be got over and it becomes more apparent with every increase in the number of specimens available. It is not peculiar to India, but to all continental areas and species with wide continuous distribution.

We do not think that there is much to be gained from the use of the \leq signs to express this intergrading. These may be useful in a report on a single collection from an isolated and little-known area. But once full material is available from a large and continuous area, one is forced to make a choice of either dropping these signs altogether or using them in such a variety of combinations that their value entirely disappears. Remembering therefore that nomenclature is but a system of labels and convenience, and not in itself an end, we have entirely dropped these symbols and have given our distributions as far as possible in general terms, placing the birds of intermediate areas under those forms with which their inclusion appears most satisfactory.

Finally, we should like to emphasize that there is still much more to be learnt about Indian birds, especially as regards distribution, migration and local movements. There is a huge area in the centre

of the Peninsula between the Central Provinces and the southern boundary of Mysore which is virtually unknown and over which we have found no indication of the distribution of the most common species. So we urge all members of the Society to write to the *Journal* on any point, large or small, on which they can correct or supplement our conclusions.

In our introductory report we emphasized the debt of gratitude which ornithologists in general, and those of India in particular, owed to Mr. A. S. Vernay for making it possible for the Society to carry out the Eastern Ghats Survey. Now that all the specimens have come to hand, we would like to add that the results have fully justified the expense and trouble involved. Many new forms will need to be described from the collection. In addition, much new light has been thrown on the distribution and races of many other species already well known in other parts of India.

In all, about 1,550 birds were collected by Mr. V. S. La Personne who is to be warmly congratulated on the keenness and energy with which he pushed through the Survey. In the course of a year's collecting in places that were often wild and very unhealthy, he maintained the greatest interest in his work until the moment when malaria proved too much for the Survey and compelled a curtailing of its programme. We are happy to be able to state that the members of the Survey are now fully recovered from the effects of their malaria. A special word of praise is due to the way in which Mr. La Personne prepared his skins. From first to last, the birds have been collected with a uniform level of technical skill that can seldom have been surpassed.

For purposes of record we have, under each species, given a list of the actual specimens collected in the course of the Survey with a summary of their measurements. Unless otherwise stated, the measurement of the bill is taken from the actual base at the skull in a direct line to the tip. The tail measurement is taken with callipers. One point is inserted between the base of the two central feathers; the other is extended to the tip of the longest feather, whether central or external. The wing and tarsus are measured in the customary way.

Under the heading of each form we have inserted the original reference, date and type locality on which that name is based. In those cases where a summary of the Indian forms is given under the account of the race obtained by the Survey, the reference is inserted in the summary and not under the heading. In these summaries we have not arranged the races in chronological order. The sequence has been determined only by the convenience of each particular case and so varies. A bibliography of papers and records referring to the Madras Presidency with a note on previous collectors who have worked there will be given as an appendix.

A map has been specially prepared under the auspices of the Royal Geographical Society to show the collecting camps and the principal features of the Madras Presidency.¹ As the camps eventually differed somewhat from the original programme, detailed

¹ This map was specially drawn by Mr. H. F. Milne, and we are much obliged to him for the excellence of his work.

on pp. 387-8 of our introductory report, we now give the following summary of them.

ITINERARY

Salem District—

8th April 1929 to 7th May 1929.

Kurumbapatti Forest Reserve 1,000-1,500 ft.

10th May 1929 to 26th May 1929.

Shevaroy Hills. Camps at varying altitudes 3,500-5,000 ft.

28th May 1929 to 9th June 1929. Foot of Chitteri Plateau 1,500-2,000 ft.

10th June 1929 to 17th June 1929. East Chitteri Hills 3,000 ft.

19th June 1929 to 24th June 1929. Plains north of Chitteri Hills 500-1,000 ft.

Trichinopoly District—

1st July 1929 to 12th July 1929.

30 miles from Trichinopoly town.

South Arcot District—

14th July 1929 to 25th July 1929.

Gingee forest and open country around Tindivanam.

South Cuddapah District—

29th July 1929 to 28th August 1929.

Balapalli. Palkonda Hills 1,000 ft.

30th August 1929 to 21st September 1929.

Kodur. Below Palkonda Hills 500-1,000 feet.

23rd September 1929 to 27th October 1929.

Guvalacheruv 1929. Seshachalam Hills 2,000 ft.

South Kurnool District—

29th October 1929 to 1st December 1929.

Diguvametta, Nallamalai Hills 2,000 ft.

2nd December 1929 to 2nd January 1930.

Cumbum Valley, Cumbum, 1,000-1,500 ft.

Godavari Delta—

4th January 1930 to 31st January 1930.

Godavari Delta.

Vizagapatam District—

4th February 1930 to 28th February 1930.

Eastern Ghats. Anantagiri 3,000 ft.

1st March 1930 to 19th April 1930.

Eastern Ghats. Sankrametta 3,500 ft.

20th April 1930 to 15th May 1930.

Eastern Ghats. Jeypore Agency.

18th May 1930 return Bombay.

***Corvus macrorhynchos culminatus* Sykes.**

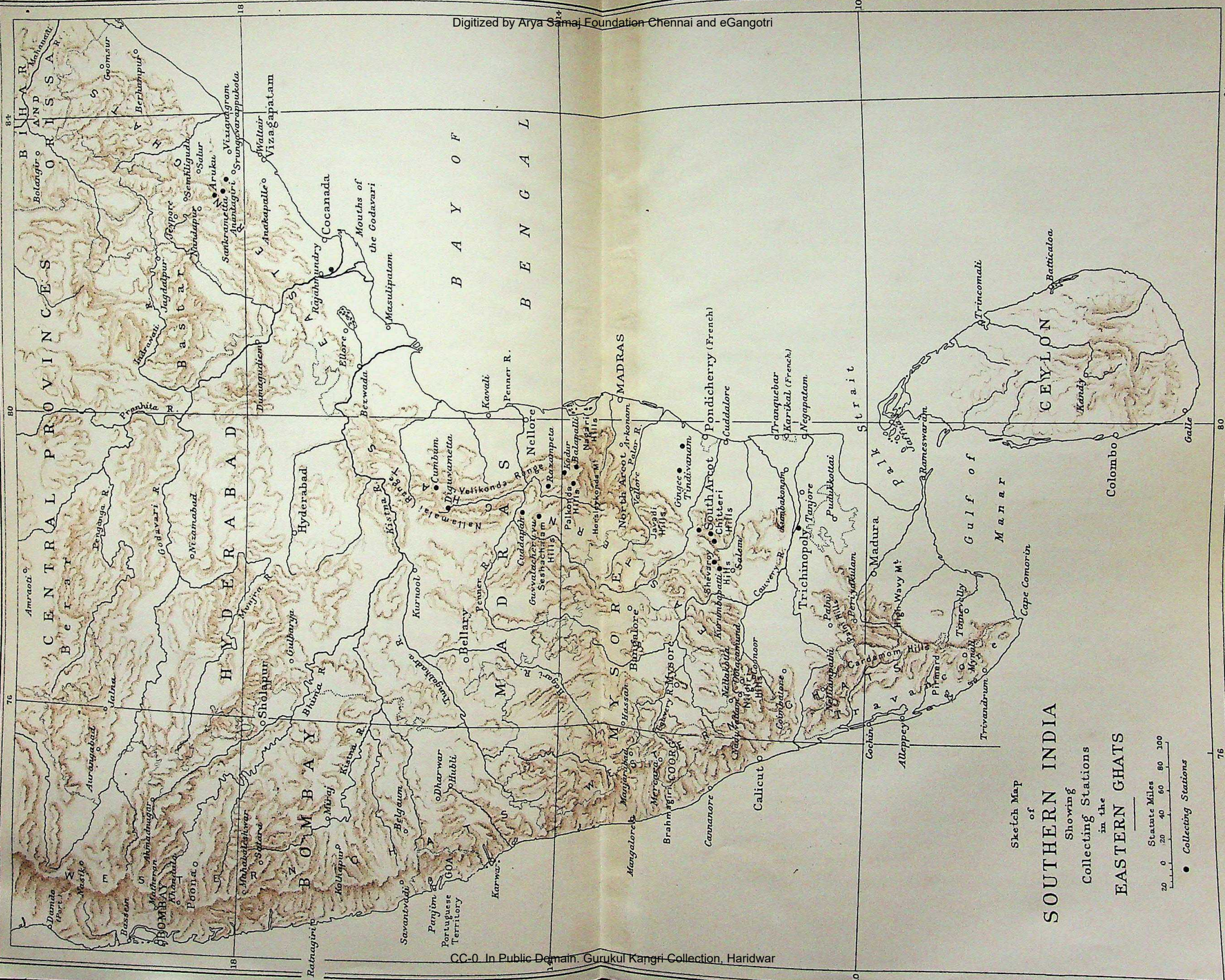
Specimens collected:—91 ♀ 19-4-29, 104 ♀ 21-4-29 Kurumbapatti; 294 ♂ 30-5-29, 391 ♀ 12-6-29 Chitteri Hills, 2,000 ft.; 1412 ♀ 19-2-30 Anantagiri 3,000 ft.

Measurements—

	Bill.	Wing.	Tail.	Tarsus.
1 ♂	62	278	176	54.5 mm.
4 ♀	56 5-58	279-297	167-174	55 mm.

As remarked in our first report (xxxiv, 390) there has been much difference of opinion as to the correct systematic treatment of the Jungle-Crow. Since we wrote, the question of whether this bird should be accepted as conspecific with the Australian *coronoides* has been settled in the negative (Hartert, *Nov. Zool.* xxxv, p. 53, 1929), and in his final volume Mr. Stuart Baker has accepted the change, regarding the Asiatic forms as forming one group. He has however fallen into the error of calling the species *levaillanti*. As pointed out by Delacour (*Ibis* 1930, p. 599), *macrorhynchos* is the older and correct name.

We are by no means certain, however, that further investigation will not show that the Jungle-Crows are merely oriental races of *Corvus corone*. It must be remembered that the two forms are exceedingly difficult to differentiate both in the museum and the field, and much of the supposed overlapping on the borders of N.-W. India is demonstrably due to wrong identification.



Sketch Map
of
SOUTHERN INDIA
Showing
Collecting Stations
in the
EASTERN GHATS

Statute Miles
0 20 40 60 80 100
Collecting Stations

As regards the races of Jungle-Crow within Indian limits there has been also some difference of opinion. To take two recent instances: Mr. Stuart Baker divides the birds of the Peninsula into two races *levaillanti* and *culminatus*. The former, he considers, occupies 'the whole of India south of the Himalayas, as far South as the Deccan and on the East to about the latitude of the Madras Presidency. To the North-east it is found up to the Bay of Bengal, but East of the Brahmaputra its place is taken by the Burmese form'. *Culminatus*, on the other hand, he considers as occupying 'India in the Madras Presidency southwards, the Deccan and South through Malabar and Travancore to the South of Ceylon'.

Meinertzhagen however (*Nov. Zool.* xxxiii, 1926, p. 85) differed considerably from this treatment. He placed the boundary between the two forms far lower in the Peninsula, namely 'south at least to Madras and the Nilgiri Hills' thus making *culminatus* a synonym of *levaillanti* and using *anthracinus* of Madarasz for the Southern race. Both these writers have made the mistake of keeping the measurements of the sexes together. They have also apparently failed to appreciate the fact that at the post-juvenile moult, the wing and tail-quills are not shed but retained so that all measurements of wing and tail of birds in their first year refer to the juvenile plumage and are so quite misleading. Had they appreciated this point, Meinertzhagen would have avoided (*loc. cit.* p. 83) dismissing the type of *culminatus* 'as a very small specimen', 'an aberrant specimen and not typical'—'similar dwarf examples occur at Simla, etc., but are exceptional'. It is in fact an immature bird completing the post-juvenile moult, and perfectly normal for its age. Whilst Stuart Baker would not have required (vol. i, p. 29) to have suggested that the late Summer birds which decreased the average measurements 'may well be visitors from the plains wandering into the hills after breeding'.

It was disappointing to find that the Survey had missed the opportunity of collecting a large carefully-sexed series of Jungle-Crows. For since all writers on the subject had arrived at different results from the examination of the same material in the Hume collection, the obvious need was to get fresh material. At our suggestion, however, with the co-operation of the Indian Museum, the Nagpur Central Museum, and the Madras and Trevandrum Museums, the Society was able to collect some fresh specimens. Combined with those in the Whistler collection this new material amounted to over 70 birds, of which the majority were from the N.-W. Himalayas, Calcutta and Bombay, virtually to potypes that is of *intermedius*, *levaillanti* and *culminatus*. With this basis we have re-examined the crows in the Hume collection.

The result shows that there can be no hard and fast line of demarcation between the races. Individual variation is great so that individuals as well as first-year birds interrupt slightly any orderly sequence of measurements. But allowing for this there is a regular and gradual intergradation between the crows of the whole of India from a small-billed race in Ceylon to a large bird with a small bill in the Western Himalayas and a medium-sized bird with a deeply-bowed Raven beak in Bengal. The sequence continues eastwards until we reach the huge bird with the huge beak of Java. The facts are clear. The problem largely resolves itself into one of convenience as to the best way to express these facts.

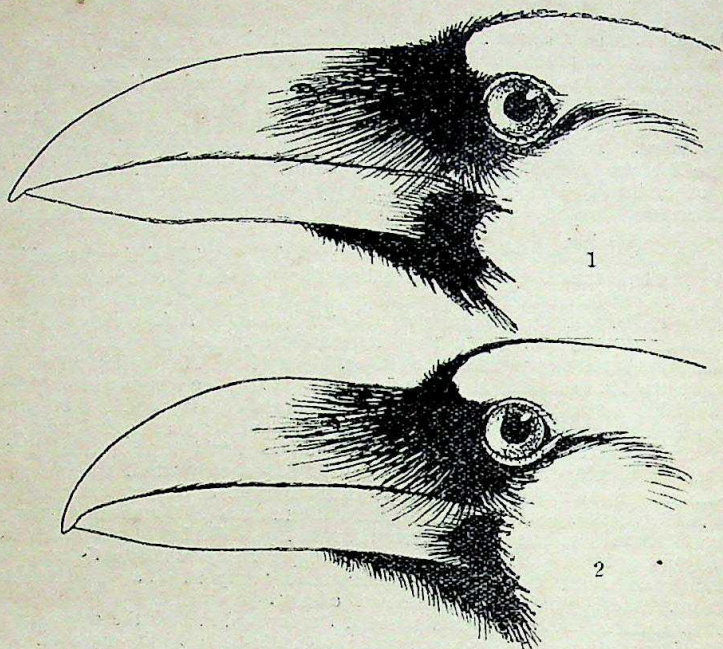
Birds from the N.-W. Himalayas present no difficulty. Their habitat is largely isolated. That the same race extends to the Eastern Himalayas is a matter of supposition. No series exists to prove the point.

It is clear moreover that birds from Ceylon and Bombay and Nagpur and Vizagapatam cannot be separated, whereas they differ most markedly from the Calcutta series¹ with the strongly curved Raven beak (*vide* text figure, p. 512). This latter we cannot separate in any way from the Assam, Burma and Andaman birds.² The measurements speak for themselves on this point.

	Bill.	Wing.	Tail.	Tarsus.
4 ♂ Calcutta	61-66	310-328	186.5-196.5	58-59 mm.
5 ♂ Andamans	60.5-67.5	265-322	167-199.5	53.5-59 mm.
8 ♀ Calcutta	55.5-65	283-305	165-182	52.5-56.5 mm.
5 ♀ Andamans	60.5-65.5	287-307	164-185	53.5-56 mm.

¹ *Corvus levaillanti* Lesson, *Traité d'Orn.* (1831), p. 328—Bengal.

² *Corvus andamanensis* Beavan, *Ibis* 1866 (October), p. 420—Andamans.

FIG. 1. *Corvus macrorhynchos culminatus*, Mahim, Bombay.FIG. 2. *Corvus macrorhynchos macrorhynchos*, Chakada, Nadia, Bengal.

The birds of the Gangetic plain of the United Provinces and Bihar are in truth intermediate between the two series; but it will be most convenient to unite them with *culminatus*, and in agreement with the established practice of regarding them as separable from the larger-billed form.

Delacour (*Ibis* 1930, 598) unites these large-billed Andaman birds with *macrorhynchos*. *Macrorhynchos* has the bill up to 73.5, and the wing up to 361 mm., a figure never reached by Andaman birds. But if we include in one form in the gradation in size from Calcutta to Java we are not accepting a wider grading of size than we get in the area assigned to *culminatus* from Ceylon to the Ganges.

We accordingly recognize the following Indian races¹ :—

Corvus macrorhynchos intermedius Adams.

Corvus intermedius Adams, P. Z. S., 1859, p. 171—Kashmir, Dagshai and Simla, restricted² to Kashmir.

A large bird with a weak bill. Plumage a comparatively dull greyish black with little gloss on the hind neck and lower parts. Base of the nape feathers usually whiter than in other forms.

	Bill.	Wing.	Tail.	Tarsus.
33 ♂	54-65	311-365	193.5-241.5	52.5-60 mm.
17 ♀	54-65	292-343	173.5-224	51-56 mm.

'Himalayas from Afghanistan to Bhutan' (Stuart Baker). It is said to breed on the boundary hills of the N.-W. Frontier but no specimens exist from this area. The extension of this race to the Eastern Himalayas is similarly unsupported by a proper series of skins.

Corvus macrorhynchos culminatus Sykes.

Corvus culminatus Sykes, P. Z. S., 1832 (July) p. 96—Dukhun = Poona.

A small bird with a strong beak. Plumage black and glossy. Base of nape feathers dusky.

	Bill.	Wing.	Tail.	Tarsus.
18 ♂	54.5-66.5	274-317	156-189	48.5-56.5 mm.
22 ♀	54.5-63	260-301	147-182.5	48.5-55 mm.

¹ Range of measurements includes adults and first-year birds.

² Stresemann, *Verhandlungen der Orn. Gesellschaft in Bayern*, xii (1916), p. 282.

The Indian Peninsula and Ceylon.

The Jungle-Crow does not occur throughout Northern India as stated in the *Fauna*. It is absent from the whole plains area north-west of a line from Delhi to the eastern border of Sindh, in which area it is largely replaced by the Raven.

Corvus macrorhynchos macrorhynchos Wagler.

Corvus macrorhynchos Wagler, Syst. Av., *corvus* sp. 3 p. 313, 1827—Java.

A large bird with a heavy deeply-bowed beak. Base of nape feathers dusky: deeper and more glossy black than other races. Measurements (Calcutta only):—

	Bill.	Wing.	Tail.	Tarsus.
4 ♂	61-66	310-328	186.5-196.5	58-59 mm.
8 ♀	55.5-65	283-305	165-182	52.5-56.5 mm.

From the vicinity of Calcutta through Assam and Burma to Java. The Andamans.

Corvus tenuirostris Moore, Catalogue, Vol. II, p. 558, 1858, is wrongly attributed to the synonymy of this species in the *New Fauna*, vol. vii, p. 2. The type is in the British Museum and is a specimen of *Corvus enca compiler* Richmond, from Sumatra, Borneo, Malay, etc.

So far as is at present known the Jungle-Crow is very generally distributed throughout the whole of the Madras Presidency except in certain of the hill ranges of the South-West. In this Presidency the bird somewhat differs in habits as compared with other parts of India. It is a very common and familiar species vying with the House-Crow as a parasite of towns and villages, occurring with that bird and often in greater numbers.

In Vizagapatam¹ La Personne found it common from the coast into the interior both in the plains and on the hills and this seems to be its status all down the eastern side of the Presidency. In the Nilgherries and the Wynad it is exceedingly common everywhere, being the common crow of Ootacamund and the other hill stations. In Coorg it is common wherever there are human habitations, occurring also, though in smaller numbers, throughout the jungle. In South Kanara and Malabar we have no information about it.

South of the Palghat Gap it is far less generally distributed. In the Nelliampathy Hills it does not occur at all according to Kinloch, and Fairbank noticed and Bates has since confirmed that it is entirely absent from the summit of the Palnis, where the former placed its limit about Vilpati 5,500 ft. Although Ferguson found it common throughout Travancore, he also noted its absence from the Southern hills.

Throughout the Presidency the breeding season appears to be fairly regular, from about February until June. In the Nilgiris most eggs will be found in April and May and this is the case everywhere. Bates however remarks that although the Jungle-Crows commence to breed about February at Madras in the drier climate of Trichinopoly, they do not start until May.

Corvus splendens splendens Vieillot.

Corvus splendens Vieill., *Nouv. Dict. d'Hist. Nat.*, viii. 1817, p. 44—Bengal.

Specimens collected:—185 ♀ 186 ♂ 4-5-29 Kurumbapatti; 537-8 ♂ 9-7-29. Vyampatti, Trichinopoly; 1040 ♀ 25-11-29 Nallamalai Range 2,500 ft.

Measurements—

	Bill.	Wing.	Tail.	Tarsus.
2 ♂	50-50.5	266-268.5	162-168.5	47-50 mm.
2 ♀	45.5-50	252-253	154.5-155	45-48 mm.

Everyone neglects this common and familiar species with the result that there is very little material for examination from lower Peninsula, India and Ceylon, though 12 fresh specimens from Calcutta and 10 from Nagpur were kindly collected for the Survey by the Zoological Survey of India and the Nagpur Museum. The five specimens collected by La Personne agree with the Calcutta series though their slightly weaker beaks remind one of the complete intergradation throughout our area between *prolegatus*, the dark Cinghalese bird and *zugmayeri*, the very pale bird of the desert and semi-desert areas of the North-west.

¹ McMaster (*J.A.S.B.* 1871, 212) curiously enough says that he could not find it at Waltair.

On the whole the House-Crow is less generally distributed throughout the Madras Presidency than the Jungle-Crow, though in the towns its numbers are certainly larger. In Vizagapatam, La Personne considered that it did not penetrate into the interior to any considerable extent and in the Godavery delta it was mainly concentrated in the towns. Throughout the rest of the Presidency east of the Nilgiris and Travancore it is evidently generally distributed, common in the neighbourhood of man and absent from forest tracts. In Madras City it is a positive pest and according to Dewar who dilates at length on its habits there, its numbers must far exceed the human population. An albino at Madras is recorded in *S. F.* ix, 507.

In the Nilgiris the House-Crow is evidently a recent colonist. Davison specifically remarks that in his day it did not ascend the hills and was absent also from parts of the low country at their base, as for instance from Goodalore to Nellacotta. While McMaster also says that the Jungle-Crow was 'the only crow of the Nilgherries, replacing his grey cousin at Kullar, the posting stage at the foot of the Kunur Ghat to which place, and no further, *splendens* had penetrated in 1870'. Bates informs us (*J.B.N.H.S.* xxxi, 291) that in the Nilgiris the House-Crow is now common; indeed almost as numerous as the Jungle-Crow. In the Wynad also it was absent from the hills in Davison's day but we have no information whether it has since colonised that area. In Coorg it is still uncommon, a few odd pairs only to be seen about the villages.

South of the Palghat Ghat the House-Crow is entirely absent from the Nelliampathy and Palni Hills, and perhaps also from the various Travancore ranges though there does not seem to be any very definite information on this point. Outside the hills it is at any rate common throughout the State.

No one has troubled to record much about the breeding of this common bird except that Dewar gives June, July and August as the breeding season in Madras City. In Vizagapatam, La Personne saw birds building in the middle of April and in the Palkonda Hills in August. In Travancore, according to Bourdillon, the eggs are not laid before June, but Ferguson took eggs in February.

In the rain area of Malabar and South Kanara, the breeding season may well agree with that of North Kanara where Davidson found that the crows bred in October and November to avoid the heavy rain.

Dendrocitta vagabunda vagabunda (Latham).

Specimen obtained :—1605 ♂ 26-3-30 Sankrametta 3,000 ft.

Measurements :—Bill 34, wing 145, tail 204, tarsus 33.

In the northern portion of the Madras Presidency down to the valley of the Godavery the Indian Tree-Pie is distinctly scarce and La Personne notes that he only saw single birds at Anantagiri and Sankrametta. The latter (♂) was secured and proves to be quite different to all specimens collected south of the Godavery. It agrees well with a female in the British Museum obtained by Blanford in January 1871 in the Godavery valley near Dumagudiam, and both birds though slightly intermediate in character must evidently be included under the typical race.

Consideration of the magpies collected by the survey immediately introduced two difficult problems, the correct name of the species and the races to be recognized in India. Of late years the name of this bird has oscillated between *Dendrocitta rufa* and *D. vagabunda*, the former being used again in the new edition of the *Fauna*. The bird was first described as *Lanius rufus*¹ by Scopoli (1786) but that name is unfortunately preoccupied by *Lanius rufus* of Linnaeus 1766. Latham in 1790 independently described it as *Corvus rufus*.² Mr. Stuart Baker is of opinion that this name may stand but we agree with Ticehurst (*Ibis* 1931, p. 585) that as *Lanius rufus* and *Corvus rufus* are admittedly the same bird the specific name is not rendered tenable by the

¹ *Lanius rufus* Scopoli, *Del. Faun. et Flor., Insul.*, vol. ii (1786), p. 86.

² *Corvus rufus* Latham Index Orn. vol. i (1790), p. 161.

Both descriptions are based on 'La Pie rousse de la Chine' in Sonnerat's 'Voyage aux Indes Orientales et la Chine', pl. 106, p. 186. As the bird does not occur east of Indo-China, Stuart Baker has fixed Malabar as the type locality.

change of genus. This being so we have no option but to use the next oldest name which is *vagabunda*. The Malabar form is then left without a name.

In our first report we mentioned the divergence of opinion between Ticehurst and Stuart Baker as to the races of the Tree-Pie in India. This has been partly reconciled by Stuart Baker's final admission (*New Fauna* viii, p. 7) of Blyths' *pallida* for the large pale birds of N.-W. India. We also said that in our opinion neither treatment was entirely satisfactory and this view has been justified by the survey series.

Ticehurst had hinted at the possibility of southern birds being separable on their smaller size, but the real position was obscured rather than suggested by the material in the British Museum. The series from south of the Nilgiris consisted of the following specimens, all old and unsexed, 4 from Madras, 1 from Calicut, 1 from Malabar and 6 from Travancore. All are precisely alike, small and richly coloured, agreeing in tint with Bengal birds. They stand out markedly however from the birds from Mysore and the Nilgiris which are pale and at a casual examination recall the birds of the north-west. Individual variation was formerly considered to cover both pale and dark birds.

The survey series however cleared up the position. All birds obtained by La Personne south of the Godavery agree in being small and very pale and quite unlike the dark birds enumerated above. It was immediately suggested therefore that this species agreed with many others in having a dark saturated race in the rain-areas of the South-West and a pale race in the dry Carnatic. The only objection to this theory lay in the four birds marked 'Madras'. Two of these are from the Gould collection and two from H. H. Baker (misspelt *Baber* on the labels which are not original). It is known that H. H. Baker's birds were mostly collected in Malabar through nothing is known of the source of these Gould specimens. All four agree so exactly with the other specimens from Malabar and Travancore and are so different to the survey series that we feel justified in concluding that 'Madras' on the labels stands not for the town but for the Presidency and that these birds came from the western side. The loose use of the word 'Madras' for the whole Presidency was a commonplace of 50 years ago and is still hardly extinct.

We accordingly recognize the following races in India :—

***Dendrocitta vagabunda vagabunda* (Latham).**

Coracias vagabunda Latham, *Index Ornith.*, vol. i (1790), p. 171—India restricted to Calcutta.¹

Large richly coloured race. Back and scapulars dark brownish rufous; rump belly and lower tail coverts fulvous buff.

	Bill.	Wing.	Tail.	Tarsus.
14 ♂	31-35	142-158.5	204-253	31-34 mm.
4 ♀	31-33	136.5-149	198-225	31-32 mm.

Outer Eastern Himalayas from Nepal to Assam, extending to those parts of India not occupied by other forms, and intergrading with them.

***Dendrocitta vagabunda pallida* Blyth.**

Crysirina pallida Blyth, *J.A.S.B.*, xv (1846), p. 30—Western Himalayas, restricted¹ to Simla.

The largest race, much paler than all others except *vernayi*. Back and scapulars isabelline with a tinge of dusky but devoid of rufous; rump paler; belly and lower tail coverts pure isabelline or buff cream colour.

	Bill.	Wing.	Tail.	Tarsus.
12 ♂	32.5-35	153-173	242-315	33.5-36.5 mm.
9 ♀	30-34	156-164	250-295	32-35.5 mm.

Outer Western Himalayas, N.-W.F.P., Punjab, Rajputana and Sindh.

***Dendrocitta vagabunda parvula* nom. nov.** for *Corvus rufus* Latham, *Index Ornith.*, vol. i (1790) p. 161 (Malabar). Similar in colour to the typical race but much smaller.

Twelve specimens unsexed measure :—

Bill	Wing	Tail
30.5-31.5	133-151.5	188.5-238.5 mm.

West Coast from S. Kanara to Cape Comorin.

¹ Ticehurst *Ibis*. 1922, p. 537.

Dendrocitta vagabunda vernayi Kinnear and Whistler.

Dendrocitta rufa vernayi Kinnear and Whistler, *Bull B.O.C.* ccxlv, vol. li, p. 17 (1930—Nallamalai range 2,000 ft. S. Kurnool).

Small race, paler even than *D. v. pallida*; the chin throat and breast are almost sooty grey and the abdomen pale creamy fulvous.

	Bill.	Wing.	Tail.	Tarsus.
12 ♂	29-34.5	144.5-157.5	201-226	31-33.5 mm.
9 ♀	29.5-32.5	139-149.5	187.5-224	31-32.5 mm.

South East India, South of the Godavery, S. E. Hyderabad, Mysore and the Nilgiris.

The above measurements include both adults and first-year birds. The latter are easily distinguishable from adults by the pale tips to the tail feathers. They are generally smaller.

D. rufigaster Gould *P.Z.S.*, 1838, p. 80, is wrongly given in the *New Fauna* (vii, p. 6) in the Synonymy of this species from which the white nape at once distinguishes it. The description agrees better with *D. occipitalis* (Muller) from Sumatra.

Dendrocitta vagabunda parvula Kinnear and Whistler.

The range of this form in the Presidency lies outside the path of the Survey. There is nothing on record to show the boundary between it and *D. v. vernayi* but it presumably is confined to the area of heavy rainfall.

In Travancore according to Ferguson it is found in the low country between the hills and the coast and does not ascend the ranges at all. It is very rare on the Nelliampathis (Kinloch) but Fairbank obtained it at 5,000 ft. on the Palnis. There is no definite information about the bird in Malabar and South Kanara beyond the specimens from the former district in the British Museum.

In Travancore according to Ferguson it breeds in the S.-W. Monsoon, that is between the middle of May and the middle of September.

Dendrocitta rufa vernayi Kinnear and Whistler.

Specimens collected:—82 ♂ 18.4-29 Kurumbapatti; 239 ♀ 17.5-29, 255 ♀ 20.5-29 Shevaroy; 375 ♂ juv. 9.6-29, 332 ♂ 11.6-29 Chitteri range 3,000 ft.; 729 ♀ 22.8-29, 770 ♀ 28.8-29 Palkonda Hills 1,000 ft.; 847 ♂ 28.9-29 Seshachalam Hills 2,000 ft.; 957 ♂ 1.11-29, 1027 ♀ 22.11-29 Nallamalai range 2,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
5 ♂	29-33	145-157.5	197-210	31-32.5 mm.
5 ♀	30-32.5	139-149.5	187.5-224	31-32 mm.

South of the Godavery, in all localities visited by the Survey from the islands of the delta, the various ranges up to 4,500 ft. (Nallamalais, Palkonda, Seshachalam, Shevaroy, Chitteri) to the plains round Kurumbapatti and Trichinopoly, the Tree-Pie was very common in all types of country and jungle. All specimens obtained in this area belong to the small pale race which we have named *vernayi* and it presumably occurs throughout the whole of the presidency down to Cape Comorin. Westwards this race extends to the Nilgiris and parts of Hyderabad and Mysore. In the Nilgiris according to Davison it is common up to 5,000 ft. more numerous at low elevations and gradually decreasing up to that limit, but in many years he only once met it above that elevation, at 6,500 ft. about 7 miles from Ootacamund. The breeding season is not recorded.

Dendrocitta leucogastra Gould.

Dendrocitta leucogastra Gould, *P. Z. S.*, 1833 (July 5), p. 57—Eastern Asia, Malabar Coast.¹

The Southern Tree-Pie was not met by the Survey and its range lies to the west of the areas worked. Its distribution is not very clearly given in the *New Fauna*. McMaster (*J. A. S. B.*, 1871, pt. 2, p. 214) states that he procured a specimen in May at Chikalda in the Gawilghur Hills, but this record certainly must be regarded with suspicion until confirmed.

The most northerly authentic records are for N. Kanara where A. T. Crawford (*S. F. x.* 422) first obtained a specimen and James Davidson later found it very

¹ The specimen in the British Museum labelled in the handwriting of Gould's Secretary 'Dendrocitta leucogaster Gould Irides blood red Malabar Coast' may safely be taken as the type.

local and confined to the ghats, and ever rare where found. His account, substantiated by specimens now in the British Museum, is as follows:—'The place I have seen it oftenest is at Nilkund on the crest of the ghats between Siddapur and Kumta. I have also seen it at Davimane on the crest of the ghats between Sirsi and Kumta and in the broken country West of Siddapur.' T. R. Bell saw a pair on the Bhara Ghat a little further north.

South of this the bird becomes far more common. There is no accurate account of its status in Mysore but, at Manzeerabad, Macgregor (*S. F.* x. 462) obtained one specimen and at Bangalore Bates found it exceedingly common, though Davison did not meet it in S. Mysore below the Nilgiris. From here it evidently extends over into our area on the Eastern Ghats near Palmaner, where Bates found it on the Munar Ghat.

It occurs in Coorg and Malabar and in the Wynaad it is very common. On the slopes of the Nilgiris it is less common but it occurs up to 5,000 ft. Although very common in the Nelliampathis, and in Travancore from the foot of the hills up to about 5,000 ft., it is curiously absent from the Palnis.

The ordinary breeding season in all parts of the range is apparently from February to April, but Baker quotes Stewart to the effect that in Travancore there is a second brood about August. Both in Travancore and in the Nelliampathis (Bourdillon *S. F.* iv, 402; Kinloch *J. B. N. M. S.*, xxix, 294) this magpie is said to associate habitually with *Dissemurus paradiseus* and further information on this point and the reason for the association is most desirable.

Dendrocitta formosae sarkari Kinnear and Whistler.

Dendrocitta formosae sarkari Kinn. and Whistler, *Bull. B. O. C.*, LI (cccxliv) 1930 (October), p. 17.—Anantagiri, Vizagapatam.

Specimens collected:—1325 ♂ 5-2-30, 1377 ♂ 12-2-30, 1390 ♂ 14-2-30, 1418 ♀ 20-2-30, Anantagiri 3,000 ft.; 1690 ♂ 16-4-30, 1696 ♂ 17-4-30, 1708 ♂ 19-4-30, Jeypore agency 3,000 ft.

Measurements—

	Bill.	Wing.	Tail.	Tarsus.
6 ♂	33-34	136.5-144.5	201-214	28-30 mm.
1 ♀	32.5	142.5	200	28 mm.

Long ago Jerdon wrote that the Himalayan Tree-Pie 'occurs very rarely on the hills of Southern India. I got a specimen said to have been killed on the Eastern Ghats and fancied that I saw it on the Seegor Pass of the Nilgheiries.' Horsfield also had one specimen from Madras.¹ (*B. of I.* ii, 316). This statement was however discredited by W. Davison (*S. F.* x. 399) and Hume lent the weight of his authority against it. The possibility of its occurrence in the Peninsula was accordingly disregarded in both editions of the *Fauna*.

Great interest therefore attaches to La Personne's rediscovery of this bird in the Vizagapatam district where he procured a good series at Anantagiri and Jeypore at elevations about 3,000 ft. His note is as follows:—'Common throughout the area under survey in Vizagapatam but not extending beyond the hill tracts. Their call was at once reminiscent of the Himalayan bird. During the months February, March and April these birds were in various stages of genital development and courtship. They were to be found in rather large numbers feeding principally on the flowers of *Bombax malabaricum*.'

These birds differ from the typical form (*E. Himalayas*) in the much smaller beak 33-34 mm. as compared with 36.5-38.5 mm. *D. f. occidentalis* (*Western Himalayas*) is an altogether larger bird, wing in ♂ 145-160 mm.

Parus major mahrattarum Hartert.

Specimens collected: 385 ♂ 12-6-29, 407 ♀ 14-6-29, 417 ♀ 419 ♀ juv. 15-6-29 Chitteri range 3,000 ft.; 963 ♀ 3-11-29, Nallamalai range 2,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
1 ♂	11	67	59.5	18 mm.
3 ♀	11-12	62-68	51-58	17.5-18 mm.

The Grey Tit appears to be scarce on the eastern side of the Presidency. There is no actual record north of the Nallamalais where La Personne procured

¹Cf. Horsf. and Moore, *Cat. Mus. H. E. I. Co.* ii, p. 569 'from Wright's collection.'

the above specimen and south of that he only met with in the Chitteri range, commenting specially on its absence elsewhere.

In the West we know more about it. In Travancore it is confined to the hills and is not uncommon, being found at all altitudes from the base to 6,000 ft. but most numerous at 3,000 ft. In the Nallampathis Kinloch says it is rare. In the Palnis Fairbank did not meet with it but Terry found it in the Pittur valley (S. F. x. 478).

Northwards it occurs all over the Nilgiris, the Wynnad and Coorg, being especially abundant near habitations on the higher ranges of the Nilgiris.

In the Nilgiris the Grey Tit breeds from February to May, and Miss Cockburn records a nest with young as late as 10th November. There is no other information on record for the presidency beyond the fact that in June in the Chitteri range the season was evidently ending. The juvenile obtained agrees with two others in the British Museum (Ahmednagar, Fairbank; Ootacamund, Gosse.) and one obtained by Dr. C. B. Ticehurst at Nasik in having the upper plumage tinged with green and the lower parts faintly washed with yellow. Another juvenile in the British Museum from Ceylon however differs in having no green or yellow tints in the plumage while the upper parts are darker than in the adult. This is probably only an individual variation as although juveniles of *caschmirensis*, *nepalensis* and *cinereus* (E. Java) examined betray their origin in the major group by possessing the green and yellow tints, two other juveniles of *cinereus* from Flores and Alor (Moluccas) are duller replicas of the adults as in the Ceylon bird.

Ticehurst (J.B.N.H.S. xxxi. 491) and Whistler (Bull. B.O.C., vol. L, p. 6, 1929) both objected to the arrangement of the Grey Tits of India in vol. i, of the *New Fauna* and their emendations were accepted in vol. vii p. 12. We are however of opinion that no arrangement is satisfactory which combines the Grey Tit of Bihar, Bengal and Assam with that of Java and the neighbouring Islands. The group is a difficult one but on series we think there should be no objection to upholding the following races in India on the distinctions indicated:—

A. Larger and paler forms.

Parus major caschmirensis Hartert.

Parus major caschmirensis Hartert, Vogel P. F., vol. i, (June 1905), p. 345—Gilgit.

- (a) Grey predominates on central tail feathers.
- (b) Blue fringes of greater coverts broad so that coverts appear blue.
- (c) White wedge on inner web of penultimate tail feather very long, 20-45 mm., almost always over 30 mm.
- (d) Outer web of penultimate tail feather practically entirely white.

	Bill.	Wing.	Tail.	Tarsus.
27 ♂	12-13	72-78	60.5-71	17-20.5 mm.
18 ♀	11.5-13	68.5-73.5	56-62.5	18-20 mm.

N.-W.F. Province, Kashmir and Western Himalayas, visiting Punjab and Western United Provinces in winter.

Parus major ziaratensis Whistler.

Parus major ziaratensis Whistler Bull B.O.C. vol. L, No. cccxxv (October 1929), p. 6, Ziarat, Baluchistan.

Details as in *caschmirensis* but differs in the slightly paler bluer grey of the upper parts, the greater amount of white edging on the tertiaries and in the smaller stumper bill.

	Bill.	Wing.	Tail.	Tarsus.
7 ♂	11-12	73-78	62.5-71 mm.	(not noted).
2 ♀	11.5	70.5-71.5	60 mm.	

Ziarat, Baluchistan; Kandahar, Afghanistan.

B. Smaller and darker forms.

Parus major nipalensis Hodgson.

Parus nipalensis Hodgson, Ind. Rev. 1838, p. 31—Nepal.

- (a) A wide band of black along shafts of central tail feathers, remainder grey.
- (b) Blue fringes of greater coverts broad so that coverts appear blue.
- (c) White wedge on inner web of penultimate tail feather 12-38 mm. usually over 25.

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(d)	Always a black line on white outer web of penultimate tail feather.			
	Bill.	Wing.	Tail.	Tarsus.
5 ♂	11·5-12	67-68	59·5-61	16·5-17·5 mm.
2 ♀	11·5-12	62·5-65	54	17 mm.

Lower Nepal, Bihar, Bengal, Duars and Assam.

Parus major mahrattarum Hartert.

Parus major mahrattarum Hartert, *Nov. Zool.*, vol. xii (September 1905) p. 499—Ceylon.

- (a) Central tail feathers black, a line of grey down the outer web.
 (b) Blue fringes of greater coverts narrow, so that coverts appear black with blue edges.
 (c) White wedge on inner web of penultimate tail feather 6·5-34 mm., usually over 25.

(d)	Sometimes a black line on white outer web of penultimate tail feather.			
	Bill.	Wing.	Tail.	Tarsus.
18 ♂	10-12·5	62-73·5	51-60·5	16·5-19 mm.
7 ♀	10·5-12	61-68	48·5-58	15·5-18 mm.

India south of and including Mt. Abu, Central Provinces and Orissa; Ceylon.

In order to show why we have separated *P. m. nepalensis* we enumerate the corresponding points of.

Parus major cinereus Vieillot.

Parus cinereus Vieillot, *Nouv. Dict. d'Hist. Nat.*, nouv. ed. vol. xx, (1818), p. 316 ex Levaillant pl. 139, fig. 1—Batavia.

- (a) A narrow band of black along shafts of central tail feathers, remainder grey.
 (b) Blue fringes of greater coverts narrow, so that the coverts appear black with blue edges.
 (c) White wedge on inner web of penultimate tail feather small, 2·5-23 mm., usually under 20.
 (d) Outer web of penultimate tail feather black, except for a white tip.
 There appears to be no difference in size.

[*Parus nuchalis* Jerdon.

Parus nuchalis Jerdon, *Madras Jour. Lit. Sci.* xiii (1845), p. 131—Eastern Ghats.

Jerdon obtained his type of the White-winged Black Tit 'from the Eastern Ghats, west of Nellore' where it was said by the shikaris who produced it to be very rare. It is difficult not to feel that there must be some mistake (in spite of the further statement by Jerdon that it had since been obtained by Dr. Stewart at Bangalore) when a bird which is definitely known to be characteristic of the dry country of Rajputana is recorded on native testimony from the densely wooded and moist Eastern Ghats. Jerdon's and Stewart's specimens apparently no longer exist and Hume was inclined to think that when rediscovered, the bird of the Eastern Ghats would prove distinct from that of Rajputana. Unfortunately the Survey has thrown no light on the point.]

Machlolophus xanthogenys aplonotus (Blyth).

Specimens collected: 1320 ♀ 4-2-30, 1334 ♂ 6-2-30, 1348 ♂ 7-2-30, 1378 ♂ 12-2-30, 1383 ♂ 1385-6 ♂ 13-2-30, 1397 ♀ 16-2-30, 1398 ♂ 17-2-30, 1432 ♂ 21-2-30, 1434-5 ♂ ♀ 23-2-30, Anantagiri 3,000 ft.; 1471 [♀] 4-3-30 Sankrametta 3,500 ft.; 1692 ♂ 17-4-30, 1728 ♂ 26-4-30 Jeypore agency 3,000 ft.; 1752 ♂ 2-5-30, 1774 ♂ 5-5-30 Anantagiri 3,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
13 ♂	12-13	70·5-77·5	54-60	18 -19·5 mm.
4 ♀	12-12·5	70 -71	52-53	18·5-19 mm.

The Yellow-cheeked Tit is widely spread in Peninsula India, chiefly as a bird of the elevated plateau and hill ranges, and this area is separated from that of the typical race (Western Himalayas) by the great Gangetic plain. The Peninsula birds have hitherto been treated as belonging to one race but an examination of the material shows that this is not correct.

If birds from Travancore are compared with those from Mt. Abu (i.e. from the extremities of the Peninsular distribution) it is at once evident that they are different. The former differ from the latter in (1) the larger size; (2) the duller more saturated green of the upper plumage as compared with bright yellow green; (3) the duller darker blue edging to the wings, the marked reduction of

the white tips of the tertiaries, and the smaller white spots on the median and greater wing coverts; (4) the duller and more olive green colour of the yellow parts of the lower plumage.

The following table shows comparative measurements of the three forms, males only, and explains also why previous writers have disagreed as whether *aplonotus* (in which they included both northern and southern birds) was the larger than *xanthogenys* or not.

	Bill.	Wing.	Tail.	Tarsus.
<i>xanthogenys</i>	12 -12.5	71.5-76	54.5-60	18-19.5 mm.
<i>aplonotus</i>	12 -13	70.5-77.5	54 -60	18-19.5 mm.
Southern birds	12.5-14	76.5-82.5	57.5-62.5	19-19.5 mm.

As in other birds of Peninsula India there is a gradual passage from one form to the other. After a careful comparison of the survey series and other material available we consider that all specimens from the Konkan southwards should be grouped together and all Peninsula birds from Mahabaleshwar northwards should form another group to which belong the survey series from Vizagapatam district. To the latter group the name *aplonotus* rightly belongs.

We have considered whether *Parus jerdoni* Blyth, *J.A.S.B.* xxv (1856), p. 445, could be used for the southern race. The type apparently does not exist. Blyth said that his specimen was amongst a collection of birds sent on inspection by Dr. G. Buist on behalf of the Bombay branch of the Asiatic Society but no hint was given of the actual locality. The description is not clear enough to refer conclusively to either race and in any case Blyth was thoroughly confused over these Tits (*vide* Hume *S. F.* vii, p. 405 foot-note). We have therefore thought it desirable to name it as

Machlolophus xanthogenys travancorensis subsp. nov.

Type ♂ 12 Nov. 1878, Myñall, Travancore (Bourdillon). Brit. Mus. No. 80-8-19, 109.

The races will therefore stand as follows :—

Machlolophus xanthogenys xanthogenys (Vigors).

Parus xanthogenys Vigors *P.Z.S.*, vol. i (1831, Feb.), p. 23—Himalayas, Simla—Almora district.¹

Western Himalayas from Murree to Nepal (but apparently not Sikkim as usually stated). Breeding about 5,000 ft. to 7,000 ft.

Machlolophus xanthogenys aplonotus (Blyth).

Parus aplonotus Blyth, *J.A.S.B.* xvi (1847), p. 444—Chaibasa, Singhbhum. Mt. Abu: Parisnath Hill: locally at all elevations in the Central Peninsula from Mhow, Saugor and Orissa down to a line from Poona to the Godavery valley.

Machlolophus xanthogenys travancorensis Kinnear and Whistler. subsp. nov.

The Western Ghats and neighbouring wooded areas from S. Konkan to the Asambo Hills, at all elevations.

When the contact zone of *M. xanthogenys* and *M. spilonotus* in Nepal is understood we suspect that *M. s. spilonotus* (E. Himalayas and Assam) and *M. s. subviridis* (Burma and Tenasserim) will prove to be also races of *M. xanthogenys*.

In the Madras Presidency *M. x. aplonotus* (as above defined) is only found in the extreme north. The Survey met with it in the Vizagapatam district whence La Personne notes :—'Extremely common around Anantagiri and extending well into the interior. Absent from the plains. Not quite so numerous in the Padwa Valley but I believe these Tits are common in the hill tracts of Koraput and Jeypore. Breeding during the latter end of April, a nest being found in a coffee plant. These Tits feed chiefly on the flowers of *Bombax malabaricum* in company with *Zosterops*, *Sitta* and *Phylloscopus*. I have seen them chase and devour flying ants.'

A male from Jeypore 4th March 1877 (Hume Coll.) is the only other known record for our limits. The bird is strictly a resident.

The breeding season is not easy to define but in the north of Peninsula India it is apparently from April to August, whilst about Poona it is certainly later from July to October as in *travancorensis*.

The series collected by La Personne introduce an interesting problem with regard to the plumages of the Tits of this genus. The fifteen males all agree in being black crested and in having a broad longitudinal black band from the

¹ *Ibis*, 1924, p. 471.

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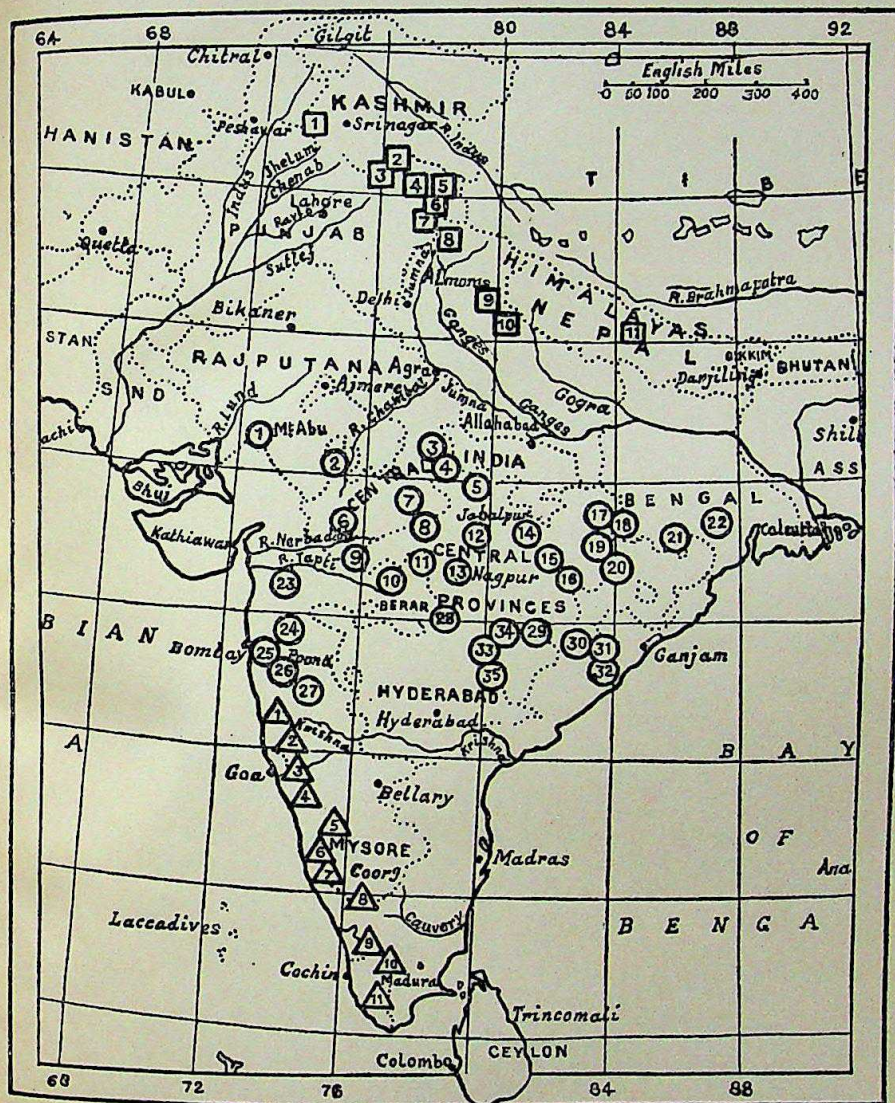
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MAP TO ILLUSTRATE THE DISTRIBUTION OF THE RACES OF *MACHLOLOPHUS XANTHOGENYS*.



MACHLOLOPHUS X. XANTHOGENYS.

Numbers in square
brackets.

1. Murree
2. Chamba
3. Dalhousie
4. Dharmasala
5. Kulu
6. Koteghar
7. Simla
8. Mussoorie
9. Naini Tal
10. Ranikhet
11. Nepal Valley

MACHLOLOPHUS X. TRAVANCORENSIS.

Numbers in triangular
brackets.

1. S. Konkan
2. Belgaum
3. Castle Rock
4. N. Kanara
5. Mauzeerabad
6. Coorg
7. Wynad
8. Nilgiris
9. Nelliampathies
10. Palnis
11. Travancore

MACHLOLOPHUS X. APLOTOTUS.

Numbers in round brackets.

- | | | | |
|--------------|------------------|-----------------|-------------------|
| 1. Mt. Abo | 10. Melghat | 18. Jashpur | 27. Mahableshtar |
| 2. Neemuch | 11. Chikalda | 19. Udalpur | 28. S.-E. Berar |
| 3. Jhalawar | 12. Beetul | 20. Sambalpur | 29. Bastar State |
| 4. Goona | 13. Nagpur | 21. Chaibasa | 30. Jeypore |
| 5. Saugor | 14. Moti Nala | 22. Parasnath | 31. Sankrametta |
| 6. Mhow | 15. Majgon, Kapa | 23. W. Khandesh | 32. Anantagiri |
| 7. Sehore | 16. Balaghat | 24. Egutpura | 33. Wardha Valley |
| 8. Pachmarhi | 17. Raipur | 25. Lanoli | 34. Pranhita |
| 9. Satpuras | 18. Sirguja | 26. Poona | 35. Yenchapali |

chin to the vent. This is usually described as being the adult plumage common to both sexes. The three females on the other hand (and an unsexed bird agreeing with them) differ in having the black band replaced by dull olive green. It is evident therefore that either the sexes differ or the bird takes a year to assume the adult plumage. Either explanation is unusual in the *Paridae*.

Examination of the large series in the British Museum has not settled the problem owing to the scarcity of juvenile birds and the fact that the sexing of all specimens is not reliable. Both green and black banded specimens are found in other parts of the range but the only juvenile which we have been able to examine (5-8-1868 Mt. Abu, King) although marked ♀ agrees with the adult ♂ in being black banded and black crested. A first winter ♂ still retaining the juvenile wing coverts (16-10-1911, Nagpur: Central Mus. Col. No. 165) is black banded.

An examination of the series of *travancorensis*, only makes the puzzle more complete. In this area we find not only the black and green banded forms, both with a black crest but also a third type of apparently mature bird. This is green banded but has the crest also green like the colour of the back, the feathers centred with blackish shaft stripes. The black on the lores of *travancorensis* and the broad black line through the ear coverts are replaced by dark green slightly darker than the green of the back. There are six specimens of this type in the British Museum, viz. :—

♀ 31-4-67 Ootacamund	Hume Coll.	♂ 10-12-74 Mynall	Bourdillon.
♀ 20-4-69 Nilgiris	Theobald	o? 'Malabar'	Tweeddale Coll.
♀ 19-4-69 Coonoor	Carter	o? 'India'	Jerdon.

Although these specimens have always been passed over as a stage of plumage of the species under review we cannot fit them into the known facts and it is not impossible that they represent an overlooked species from the rain forests of the S. W. of India. But we hesitate so to describe them until the plumages of the *xanthogenys* group are fully understood.

From the area of *travancorensis* 3 juveniles exist, one in the British Museum marked ♂ Coonoor 28-8-76 (Wardlaw-Ramsay) and two, unsexed, in the Whistler collection (22-12-01, Sigur Ghat, H. R. Baker). All agree in being dull versions of the black crested, green banded plumage.

We suspect that the Coonoor bird is wrongly sexed and that *travancorensis* and *aplonotus* agree in having the sexes different; the juveniles of the two sexes agreeing with the respective adults. Examination of other members of the genus does not throw light on the matter as there is evidently no uniformity. In *xanthogenys xanthogenys* the sexes are alike and four juveniles examined agree with the adults. In *spilonotus spilonotus* the female differs from the male in a marked restriction of the amount of black on the chin and throat and the black is apparently never replaced by olive green. In *spilonotus subviridis* on the other hand the adult male and female are alike, but in both sexes in the first winter plumage the black band is replaced by dull olive green.

The correct solution of these difficulties must be left to workers in the field. Careful dissection of a few specimens will soon settle the matter.

Machlolophus xanthogenys travancorensis

This south-western race of the Yellow-cheeked Tit is common in the western side of the Presidency, but it was not met with by the Survey. It is a common member of hunting parties of small insectivorous birds in Coorg and the Wynaad, right through to the Nilgiris. It does not ascend to the plateau or above 6,000 ft. in the Nilgiris, there occupying a lower zone than *Parus major mahrattarum*, a curious reversal of the zones of the respective races of these two Tits in the Western Himalayas.

In the Nelliampathis it is extremely common, though apparently less so in the Palnis. In Travancore it is said by Bourdillon and Ferguson to be a high elevation bird, abundant from 3,000 ft. upwards.

Evidently a late breeder from July to August and possibly even later.

***Sitta castanea castanea* Lesson.**

The typical form of the Chestnut-bellied Nuthatch is confined in the Presidency to the western side. Birds from this area are not separable from those of the north. Although it occurs in the Wynaad and Malabar, round the base of the Nilgiris and in the Palghat hills it nowhere appears to be as numerous in our

area as it is in northern India. Nothing is recorded about the breeding season in this area.

***Sitta castanea prateri* subsp. nov.**

Specimens collected: 1325 ♂ 5-2-30, 1366 ♂ 10-2-30, 1413-4 ♂ ♀ 20-2-30, 1429 ♀ 22-2-30, 1435 ♂ 23-2-30, 1443 ♀ 26-2-30 Anantagiri 3,000 ft.; 1536 ♀ 14-3-30, 1679 ♀ 12-4-30 Sankrametta 3,500 ft.; 1725 ♂ 24-4-30, 1746 ♀ 29-4-30 Jeypore agency 3,000 ft.

Measurements:—

	Bill.	Wing.	Tail.	Tarsus.
5 ♂	21-22	77-5-82	40-5-43	17-18-5 mm.
6 ♀	20-22	75-78-5	38-41	17-18-5 mm.

This Nuthatch, which Jerdon had already recorded as common in Gumsoor and the Northern Circars, was found by La Personne to be common throughout the hills of the Vizagapatam district where it was evidently breeding, chiefly at 3,000 ft. Birds were observed carrying food as early as 3rd March. They were not met with in any of the other collecting camps. The good series collected are very uniform in size and colour and differ from *Sitta castanea castanea* in their longer bills, in the paler underparts of the ♂ and in the colour of the lower tail coverts which are ash-grey with narrow pale subterminal bands and chestnut fringes. As the large series of the typical form examined from the rest of the Peninsula are remarkably constant in size and colour, we have no hesitation in accepting this race from the upper Eastern Ghats, and, in its name, have much pleasure in recognizing Mr. Prater's great services to Ornithology. Topotypes of this common species cannot be traced in any collection but we have no reason to think that Bengal birds differ from those of the rest of the Indo-Gangetic plain.

The Indian races of this species will stand as follows:—

***Sitta castanea almora* Whistler.**

Sitta castaneiventris almora Whistler, *Bull. B.O.C.* li, (Nov. 1930), p. 27—between Pethora and Almora.

Beak very heavy, underparts in ♂ cinnamon brown, under tail coverts ash-grey with broad white subterminal patches and cinnamon fringes.

Western Himalayas.—

	Bill.	Tail.	Wing.	Tarsus.
7 ♂	21-5-23-5	84-87	40-44	18-20 mm.
5 ♀	21-24	79-85	40-43-5	18-19-5 mm.

***Sitta castanea cinnamomiventris* Blyth.**

Sitta cinnamomiventris Blyth, *J.A.S.B.* vol. xi (1842), p. 459—Darjeeling.

Beak very heavy, underparts in ♂ chestnut brown, in ♀ slightly richer than in last, under tail coverts as last but fringes chestnut. Nepal and Eastern Himalayas to Assam.

	Bill.	Wing.	Tail.	Tarsus.
13 ♂	19-23-5	81-86-5	38-5-45	18-20 mm.
7 ♀	18-21-5	77-5-82	38-41	17-18-5 mm.

***Sitta castanea castanea* Lesson.**

Sitta castanea Lesson, *Traité d'Orn.*, 1830 (Sept. 25), p. 316—Bengal.

Beak fine and short. Underparts in ♂ deep chestnut brown, darker than in the last. Under tail coverts ash-grey with chestnut fringes. India. Generally but only locally distributed.

	Bill.	Wing.	Tail.	Tarsus.
20 ♂	18-20-5	72-81	36-41	16-18-5 mm.
15 ♀	18-20-5	71-5-78	35-5-38-5	16-18 mm.

***Sitta castanea prateri* Kinnear and Whistler.**

Beak medium sized. Underparts in ♂ as *c. cinnamomiventris*. Under tail coverts ash-grey with narrow pale subterminal bands and chestnut fringes.

The underparts of the females of *c. castanea* and *c. prateri* are paler and pinker in colour than in the other two races.

	Bill.	Wing.	Tail.	Tarsus.
5 ♂	21-22	77-5-82	40-5-43	17-18-5 mm.
6 ♀	20-22	75-78-5	38-41	17-18-5 mm.

***Sitta frontalis frontalis* Swainson.**

Sitta frontalis Swains., *Zool. Illus.*, Ser. i, pt. i, 1820 (1st October), pl. 2—Ceylon.

VERNAY SCIENTIFIC SURVEY OF EASTERN GHATS 523

Specimens collected: 225 ♂ 15-5-29, 267-8 ♂♂ 23-5-29 Shevaroy Hills, 3,500 ft.-4,000 ft.; 401 ♀ 13-6-29 Chitteri Hills 3,000 ft.; 1370 ♂ 11-2-30, 1438 ♂ 25-2-30, 1,444 ♀ 26-2-30 Anantagiri 3,000ft.; 1470 ♂ 4-3-30, 1,584 ♀ 23-3-30 Sankrametta 3,500 ft.

Measurements:

	Bill.	Wing.	Tail.	Tarsus.
6 ♂	15-16	71·5-78·5	39-43·5	15-16·5 mm.
3 ♀	14·5	71·5-74	36-41·5	15-15·5 mm.

There has been some confusion over the type locality of this species which in the *Fauna*, vol. i, p. 132 is given as Java and in vol. viii, p. 25 as Ceylon. The latter is correct as explained in *J.N.H.S.* Siam vol. v, pt. 3, 334 (1924).

The distribution given for this species in India in the *Fauna* is perhaps too sweeping—'the whole of India east of Bombay, Gwalior and Kumaon'. It is found on the mountain ranges of the Western Ghats from about Khandesh to the extreme south of Travancore; on the Shevaroy; in the hilly country from Dholbhum to Vizagapatam; and in the submontane valleys of the Himalayas from Kumaon eastwards. Apart from these areas, I can trace only isolated records for Gwalior and Saugor and Betul district, C.P. The bird is certainly not generally distributed.

Careful examination of all available material confirms Ticehurst's statement (*J.B.N.H.S.*, xxxi, 491) that Himalayan birds are smaller than the typical race and should be separated as *S. f. corallina* Hodgson, *J.A.S.B.*, v (1836), p. 779—Nepal.

	Bill.	Wing.	Tail.
7 ♂ Sikkim	14·5-16	72-76·5	38·5-40 mm.
3 ♀ "	14	70-72	38 mm.

Birds from the Nilgiris, Palnis and Travancore agree with those from Ceylon and measure as follows:—

	Bill.	Wing.	Tail.
3 ♂ Ceylon	16-16·5	76-77	39·5-41 mm.
19 ♂ Nilgiris Palnis Travancore }	15·5(2), 16·5-17·5	77-83·5	39·5-46 mm.
3 ♀ Ceylon	16-17	72·5-79	38·5-41 mm.
10 ♀ Nilgiris, etc.	15(1), 16-17	74·5-83·5	39-45·5 mm.

As measurements alone distinguish the races and intergradation occurs in the few specimens available from the range of the bird between the Nilgiris and the Himalayas it will be convenient to consider all birds south of the Indo-Gangetic plain as belonging to the typical race; whilst the small Himalayan form extends through Burma to Java.

In the presidency the Velvet-fronted Nuthatch is widely distributed as a resident hill bird though its range on the eastern side is not properly known. Jerdon met with it in Gumsoor, and in the Vizagapatam district, La Personne found it common everywhere about 3,000 ft. It has not been yet recorded between there and the Shevaroy Hills and Chitteri Hills where it is common about 3,000 ft.-4,000 ft.

It is common throughout the S.W. group of ghats, the Nelliampathis, Palnis and Travancore Hills, apparently at all elevations, growing commoner above 2,000 ft.

In the Nilgiris it reaches its greatest degree of abundance spreading from there through the Wynaad, Coorg and the forests of the Malabar coast.

The breeding season in the presidency is from February to April and appears to be well defined.

***Garrulax delesserti* (Jerdon).**

Crateropus delesserti Jerdon, *Madras Jour. Lit. Sci.* x, 1839 (December), 256.—Kotagherri.

The Wynaad Laughing Thrush is peculiar to the Western Madras Presidency. It is found, but not very commonly, in the Brahmagiris, the Wynaad, and on the slopes of the Nilgiris down to the Palghat hills. South of the Palghat gap it is found in the Nelliampathy Hills and southwards throughout the whole of the Travancore hills at all elevations; in this area it is apparently far more common. Curiously enough however it does not occur in the Palnis so far as is known.

¹ By a slip printed as west.

Ferguson states that in Travancore it breeds in June. Stuart-Baker however says of Travancore 'the breeding season is March to May, but Mr. Stuart has taken eggs in February and again in August'. There is no information for the other parts of its range.

Trochalopteron cachinnans (Jerdon).

Crateropus cachinnans Jerdon, *Madras Jour. Lit. Sci.* x, 1839 (December) 255 Nilgiris.

Confined to the Nilgiris where it is exceedingly common at all elevations above 4,000 ft. The Nilgiri Laughing Thrush breeds from February to June and occasional nests may be found with eggs in July.

Trochalopteron cachinnans cinnamomeum Davison.

Trochalopteron cinnamomeum Davison, *Ibis*, 1886, 204 (locality unknown).

Nothing is known of this bird beyond the fact that Davison discovered two specimens of it in the Museum at Trivandrum, Travancore which were said to have been brought from the west coast of India, though the actual locality was never verified. The Palghat Hills have been suggested. We cannot help thinking however that the colour of the specimens is due to stain and that there is really no subspecies of this bird.

Trochalopteron jerdoni jerdoni (Blyth).

Garrulax (?) jerdoni Blyth, *J.A.S.B.*, xx (1851), 522 no locality—Banasore Peak.

Peculiar to the Madras Presidency. Jerdon obtained the type at about 5,000 ft. 6,000 ft. at the top of the Banasore Peak, a high hill at the edge of the ghats separating Malabar from the Wynaad (*B. of I.* ii, 50). Later, Davison obtained a series of 12 specimens from the Bramagherry Hills in Coorg which are about 20 miles away from Banasore (Balasore) and in sight of it. These remain the only authentic records of what must be considered one of the rarest birds of India.

R. W. Morgan (*S. F.* ii. 532) considered that he had met with the Banasore Laughing Thrush on the Palghat Hills and the Chinnakonoor Ghat of the Nilgiris, but it is by no means certain that he did not really observe one of the other allied forms.

Trochalopteron jerdoni fairbanki. Blandford.

Trochalopteron fairbanki Blandford, *J.A.S.B.* (1869) xxxviii, pt. 2, p. 175—Palni Hills.

Confined to the Madras Presidency. In the first edition of the *Fauna*, Oates gave the range of this bird as 'the Palnis and Anamulli Hills in South Travancore above 3,000 ft.' This was very misleading as pointed out by Ferguson (*J.B.N. H.S.*, xv, 257) but unfortunately the second edition of the *Fauna* did not profit by the correction.

In *Southern* Travancore it is not found at all. It is common in *North* Travancore at 5,000 ft. and upwards on the Kanan Devan Hills, or High Range, the highest peak of which, Anaimudi, is the centre from which spring the Palnis and Anamallais, where it is also common. These two ranges are not in Travancore but in British Territory.

A specimen in the Bombay collection was obtained by Prater on 15-5-17 in the High Wavy Mountains of Madura.

The breeding season is from April to June.

The change of the trivial name in the new *Fauna* from Palni to Travancore Laughing Thrush is probably a slip. It is at any rate undesirable. A very good account of its habits and nidification by Capt. R. S. P. Bates will be found in the *Journal*, vol. xxxv, pp. 204-7.

Trochalopteron jerdoni meridionale. Blandford.

Trochalopteron meridionale Blandford, *Proc. As. Soc. Bengal*, 1880 (November), p. 184—S. Travancore Hills [Mynall].

Peculiar to the Madras Presidency. Here again the *New Fauna* (i. p. 179) is at fault in the distribution. It does not occur in *North* Travancore as stated but is confined to the summits of the hills above 3,500 ft. in *South* Travancore up to and including the Achankovil gap (Autchincoil gap of the *Fauna*).

The breeding season is not recorded.

(To be continued.)



John Dale Scora & Danielsson, 134 London.

THE COLOURED STERCULIA.
Sterculia colorata, Roxb.
(about $\frac{1}{2}$ nat. size).

SOME BEAUTIFUL INDIAN TREES.

BY

E. BLATTER, S.J., Ph.D., F.L.S., AND W. S. MILLARD, F.Z.S.

PART VIII.

(With two coloured and two black and white plates and 6 diagrams.)

(Continued from page 296 of this volume.)

THE COLOURED STERCULIA

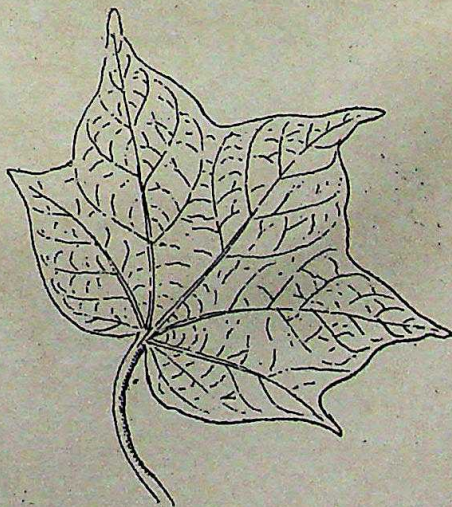
Popular Names : Bodula, Walena, Samarri (Hind.); Mula (Beng.); Khowsey, Pinj (Berar); Pisi, Sisi (Kol.); Bolazong (Garo); Sitto udal, Phirphiri, Omra, (Nepal); Kanhlyem (Lepcha); Bodala, Bodal (Kumaon); Mutruk (Merwara); Lersima (Kharawar); Bhai-koi, Khowsey, Bheckhol, Samarri, Walena (Bomb.); Karaka, Karu bop-payi (Tel.); Wet-shaw, Yaseng-shaw (Burm.); Berda (Andaman).

Sterculia colorata Roxb. Hort. Beng. (1814) 50. By some called *Firmiana colorata* R. Br. (*Sterculiaceæ*).

(*Sterculia* from *Sterculus* of Roman mythology, derived from *stercus*, dung. The Romans in the height of paganism deified the objects of their greatest dislike and most immoral actions. Thus they have the gods *Sterculus*, *Crepitus*, and the goddesses *Caca* and *Petunda*. The flowers and leaves of some species of *Sterculia* are ill-smelling. *Colorata* means coloured, referring to the orange-red calyx.)

A very conspicuous tree when in flower from March to May. The tree is leafless at this period and the branches and twigs are covered with coral-red flowers and as these fade, their place is taken by the winged leaf-shaped follicles which are pink at first and turn red later. These bear on the edges one or two seeds. The tree is fairly common at Khandalla on the Western Ghats and there used to be a few trees growing in Bombay fairly recently.

Description : A large tree with a straight, sometimes fluted trunk covered with thick, scaly, ash-coloured bark and a crown of spreading branches. The leaves are crowded together at the ends of the branches. They grow on slender stalks from 4"-12" long. The leaf is broader than long; it measures 4"-8" in length and is from 5"-12" in width. It has 3-5 points formed by shallow triangular lobes which taper acutely towards the tips. In the older trees the



number of these lobes is usually three, but in the younger plants and seedlings, the number of points is increased. Young leaves and shoots are always downy. The older leaves are smooth on both surfaces, but this is a character which differs in different localities. There are varieties of this tree in which the under-surface of the old leaf is hairy. The tree commences to shed its leaves in November and is leafless from January to April, when the young leaves commence to sprout. This generally takes place after the tree has burst into flower. The Coloured Sterculia is then a conspicuous and brilliant sight. In the forests of the Western Ghats and the Deccan where the tree is common, these trees in flower appear on the hill sides and in the ravines like masses of flaming red coral. The

flowers grow in short dense panicles at the ends of the branches. Their colour varies from bright

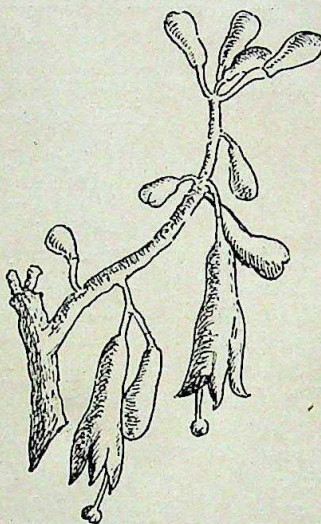
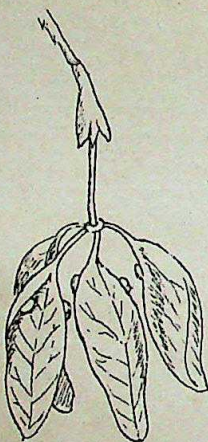
coral or orange-red to greyish brown. The stalks, the flowers and the stem on which they grow are covered with fine downy hairs, giving the whole inflorescence a soft, velvety appearance. The calyx of the flower is funnel-shaped. The petals form a long, lobed tube from which the column of the stamen protrudes, bearing at its summit about 30 yellow anthers. The style is short and recurved. The interior of the flower is deep

red. The fruits are numerous and conspicuous and might be mistaken for leaves. The fruit is composed of from 2-5 leaf-like membranous valves growing on a common stalk. These valves are green or pinkish on the outside and yellowish within. They open much before the fruit is mature, revealing usually two yellow, much wrinkled seeds the size of a small bean, adhering one to each margin of the valve.

Flowering Season: March to May. Fruits, May to June. New Leaves, April to May.

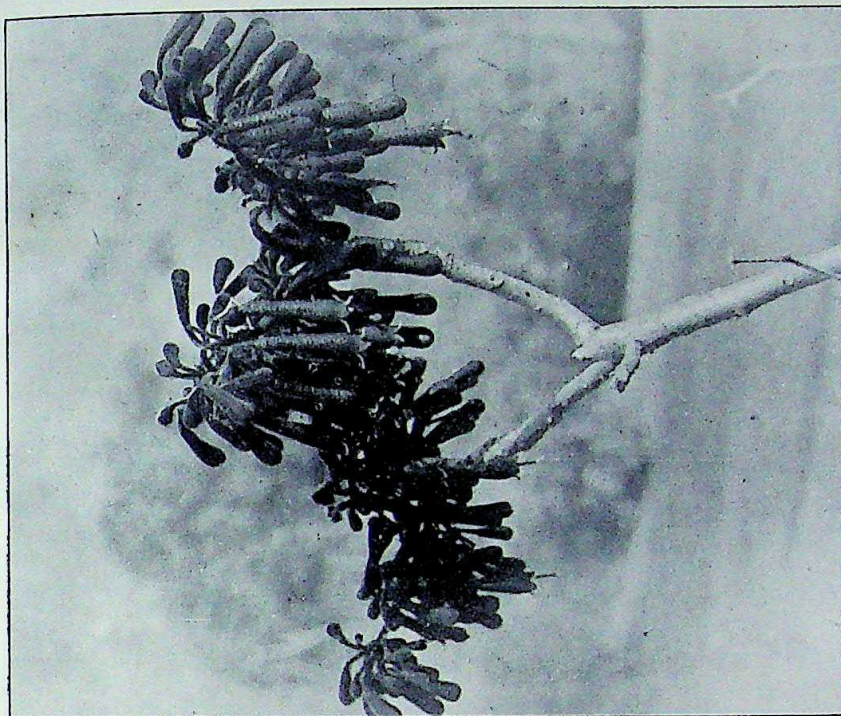
Distribution: Satpuras up to 3,700 ft ; W. Ghats from South Kanara to Travancore, Konkan and Deccan Forest, N. Circars, Mt. Abu, East Bengal, Burma, Andamans, Ceylon. Indo-China, Siam.

Uses: The bark yields an inferior fibre. The twigs and leaves are used in the W. Peninsula as a cattle fodder. The flowers are used in some parts of the country such as the Berars to decorate the horns of cattle during the Holi Festival.



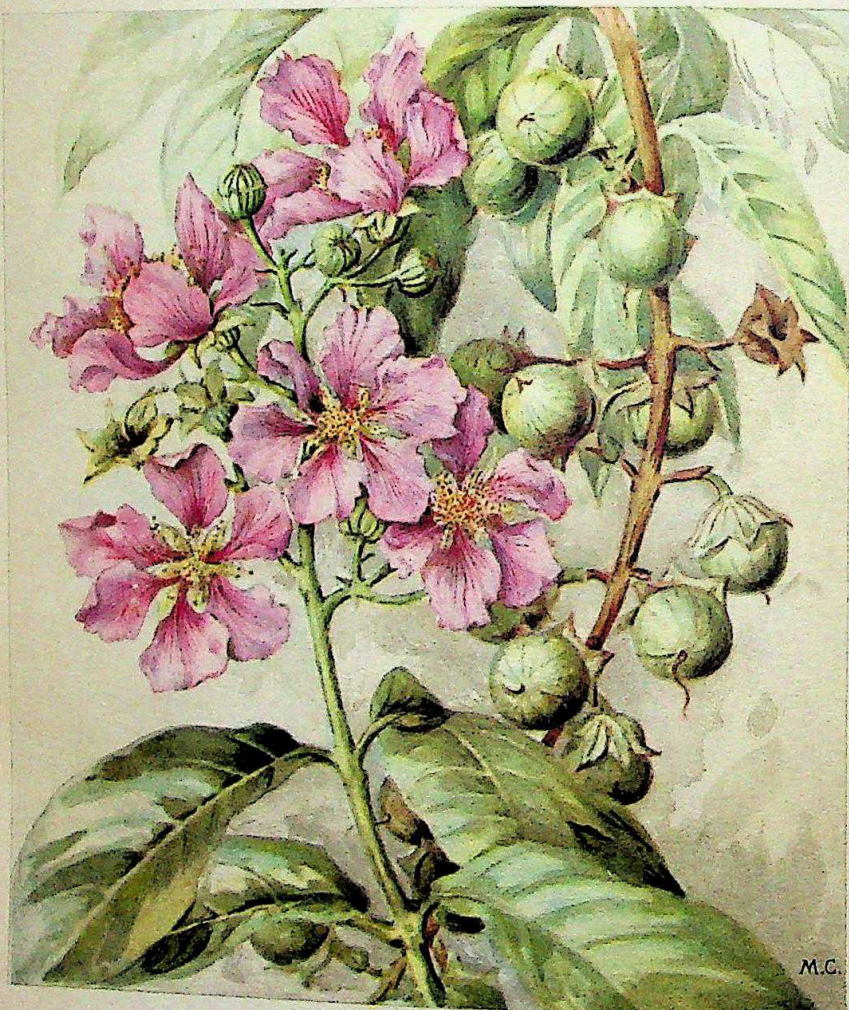


The Coloured Sterculia (*Sterculia colorata*), in flower.



Flowers of the Coloured Sterculia (*Sterculia colorata*).

Photos by C. McCann.



John Eale Seta & Danielsson, Ltd. London.

THE QUEEN'S FLOWER.
Lagerstroemia flos reginae, Retz.
(about $\frac{1}{2}$ nat. size).

SOME BEAUTIFUL INDIAN TREES

527

THE QUEEN'S FLOWER

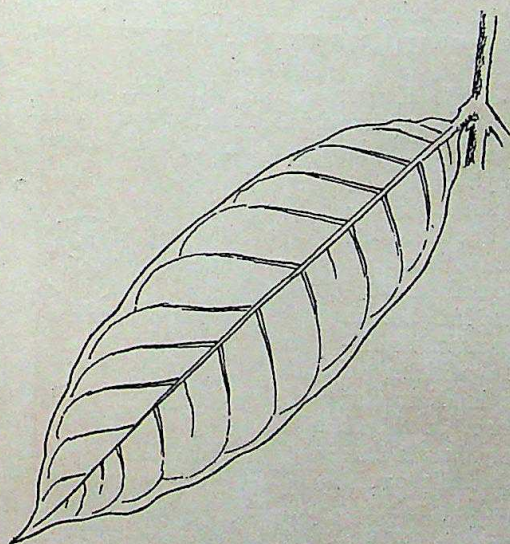
Popular Names: Arjuna, Jarul (Hind.); Jarul (Beng.); Gara Saikre (Kol.); Sekra (Santal); Ajhar, Jarul (Assam); Bolashari (Garo); Taman, Bondara (Bomb.); Bondara, Mota-bondara (Konkan); Taman, Tamana, Mota-bondara (Mar.); Kadali (Tam.); Chennangi (Tel.); Challa, Holedasal, Maruva (Kan.); Adamboe (Malay.); Konepyinma, Pyinma (Burm.); Kamaung (Magh.); Murute, Muruta-gass (Sing.); Arjuna (Sans.).

Lagerstrœmia Flos-Reginae Retz. Obs. (1789) fasc. 5, p. 25. Family (*Lythraceæ*).

(After Magnus v. Lagerstroem, 1696-1750, a Swede and friend of Linnæus; *Flos-Reginae* means flowers of the Queen.)

This tree does not grow to a large size in Bombay, about 20 feet in height only, probably because Bombay is too far North for it to excel in growth, but it is a beautiful sight when in flower from May to July. There are various shades of colour in the flowers of these trees, some being purple and others different shades of mauve, approaching to pink and these light pinkish mauve varieties are perhaps the most beautiful. The upstanding panicles of the flowers rather remind one of the shape of the white racemes of the horse-chestnut when in flower in England.

Description: A moderate sized tree but when growing on the banks of forest streams, it may reach a height of 60 ft. The trunk is straight. Its pale bark flakes off in irregular patches. The branches spread

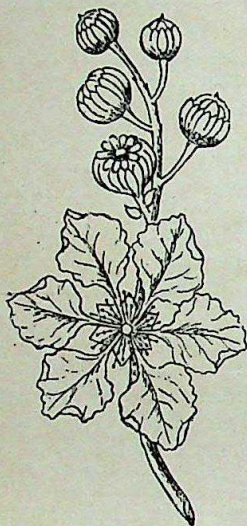


widely. The leaves grow on stout stalks; they are paler in colour below, oblong-lance-shaped and bluntly pointed at the tips. A leaf measures from 5"-8" in length and 1½"-3" in width. Its main nerves, there are from 10-13 upward curving pairs, are conspicuous and prominent. A network of fine veins covers both surfaces of the leaf.

The tree sheds its leaves during the cold weather when some of the leaves turn coppery red or yellow. But this leaf-fall is generally gradual. Few trees are absolutely bare. The

young leaves come out with the blossoms in May. Then the tree covered with great clusters of large mauve flowers is a delight to the eye. Its massed flowers have not the aggressive beauty of the Gold Mohur or the Flame of the Forest but their soft pastel colouring is tenderly attractive and pleasing. Each cluster or panicle of flowers

may be quite a foot in length springing from the branch as an upstanding spike, massed with flowers at its base and bearing numerous downy pink and green buds towards its tip. The earlier flowers at the bottom of the spike fade to a paler tone thus varying the colours of the cluster from deep to palest mauve. The colouring of the flowers varies in different trees; in some it is almost purple, in others mauve or pinky-mauve, while there is a beautiful variety in which the colours are bright pink. The calyx of the flower is green. It is covered with a white, sometimes reddish down. It has from 6 to 7 sepals which are fused together and form a heavily-ribbed cup with a lobed brim.



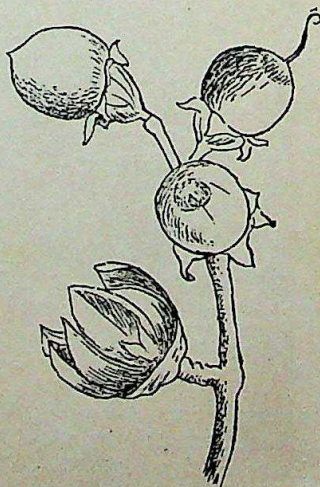
There are from 6 to 7 petals, very crinkled and wavy, rounded at the apex and clawed or narrowing suddenly at the base. The stamens are all equal, shorter than the style, they are purplish red and bear yellow anthers. The tree fruits in great profusion and the fruits persist for a long time. Green fruits of the year are seen on the tree together with blackened fruits of the preceding season. They are globular in shape

and contain smooth pale brown seeds.

Flowering Season: Flowers during the hot season and fruits during the rainy season. But young trees may be found in flower late in the rains.

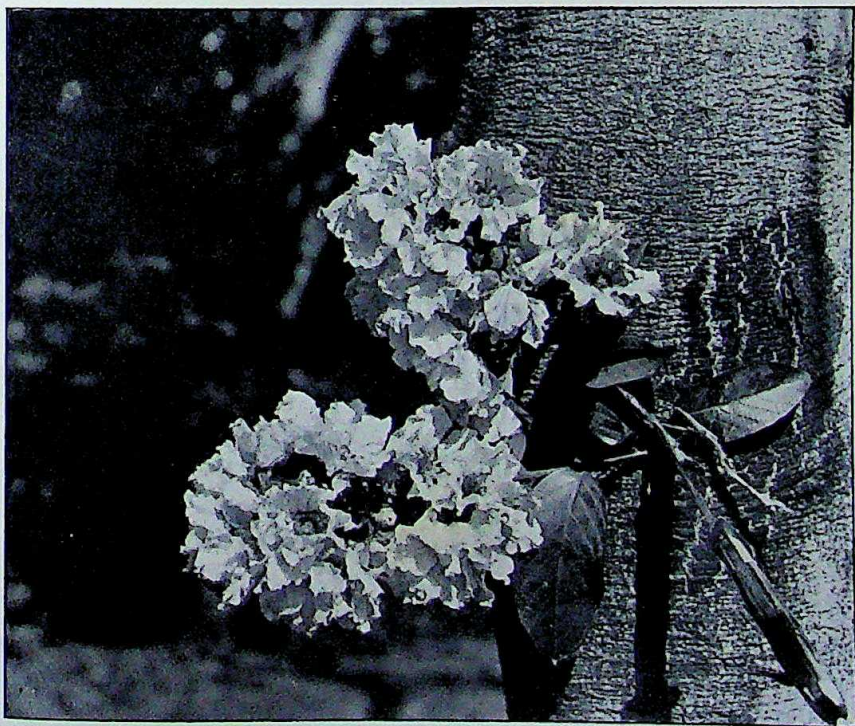
Distribution: W. Ghats* of N. Kanara and S. Konkan through Malabar to Travancore, along the banks of nalas and rivers and in swampy localities, N. Circars, Chota Nagpur, E. Bengal, Assam, Burma, Malaya, China, Ceylon. Very often cultivated, especially so in the Gorakhpur district of the United Provinces.

Leaf-shedding Flowering and Fruiting: The tree sheds its leaves about February-March, the leaves turning reddish before falling; the new leaves appear in April-May. The large terminal panicles of mauve flowers 2-3 inches in diameter, appear from April to June, at which time the trees are extremely handsome. The capsules 5-6-valved, broadly ovoid, 0.7-1 inch long, ripen from November to January, according to locality, though they do not actually open and scatter the seeds for some little time. The seeds are light brown, angular, fairly hard, with a stiff, brittle wing, the whole $\frac{3}{4}$ - $\frac{7}{10}$ inch long; they are often unfertile. The tree seeds at an early age; vigorous plants raised from irrigated broadcast





The Queen's Flower Tree (*Lagerstroemia Flos Reginae*), in flower
in the Victoria Gardens, Bombay.



Flowers of the Queen's Flower Tree (*Lagerstroemia Flos Reginae*).

sowings at Dehra Dun commenced to bear seed at the age of three years.

Gardening : 'In full blossom in the morning the tree looks as if mantled with roses, but the flowers change through the day to a beautiful purple, making it appear at evening, if seen from a short distance, like a bower of English lilacs.'—(Hunter).

During the first season the growth of the seedling is slow, a height of only 2-6 inches being ordinarily attained by the end of the year; subsequently the growth is considerably faster. Weeding and irrigation, particularly the former, greatly stimulate growth. Owing to the lightness of the seed and the small size of the young seedlings, direct sowings are less suitable than transplanting from the nursery.

Uses : This is the most valuable timber of Sylhet, Cachar, and Chittagong, and in Burma the next in value after teak. It is used in ship-building, and for boats and canoes, all kinds of construction, timber and carts.

Medicinal Uses : The root is prescribed as an astringent. The root, bark, leaves and flowers are used medicinally by the Natives. It is stated that the seeds are narcotic, the bark and leaves purgative. The fruit is used in the Andamans as a local application for aphthæ of the mouth.

Another species of the same genus is widely grown in Indian gardens: The Crape Myrtle (*Lagerstræmia indica* Linn.) called Chinai-Mendhi. It is a native of China. It is one of the most beautiful shrubs in our gardens, grows to a height of 7-8 ft. The flowers hang in branches at the extremity of the branches. The flowers are usually bright pink, but there are dark crimson, bluish, purplish and white forms. It flowers at the beginning of the rainy season. Easily propagated by cuttings or seeds.

(To be continued).

THE RHESUS MACAQUES (*MACACA MULATTA*).¹

BY

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British Museum.*

(With a plate and two text-figures.)

INTRODUCTION.

There is no monkey better known in northern India than this species, the Bandar; and no monkey is more familiar as an exhibit in the Zoological Gardens of the world where it is invariably called the Rhesus. But it has never been adequately studied from the point of view of individual, seasonal and local variation.

As I understand the species, it has a far wider geographical distribution than any other Macaque, its range extending through the Himalayas, up to 5,000 ft. or 6,000 ft., from Kafirstan and Chitral to Assam and beyond to Burma and Siam and thence northwards into the Tsheli Province of China. South of the Ganges it occurs, as far to the west as Gujerat and according to Blanford, as far to the south as the Godaveri.

Collectors for the Mammal Survey of India secured a large number of specimens, many of which are in the British Museum, and the subject-matter of this paper is based upon an examination of that material, supplemented by specimens obtained from a variety of sources and stored in the Museum.

RANGE OF COLOUR VARIATION IN THE RHESUS.

A marked specific character of this monkey is the yellowish or orange-red hue of the hind quarters where the hairs are grey or whitish in the basal half and yellow or orange in the outer half. On the fore quarters and head the hairs are typically annulated with orange or buff and blackish or grey. But sometimes a generally orange or yellowish hue pervades the whole of the upper side, although it is never so intense on the fore back, shoulders and head as on the rump and thighs. It may be crudely asserted that the species has an innate tendency to erythrism; and in monkeys addicted to that variation degrees in the brightness and extension of 'russet' are untrustworthy criteria for subspecific differences.

As an instance of individual variation in the species I will describe two adult males of almost exactly the same size and collected by H. W. Wells at Rajapara in South Kamrup, 600 ft. alt., one on

¹ For the substitution of the name *Macaca mulatta* for *Macacus rhesus* and for the disentanglement of the involved synonymy of this species, see the paper by Hinton and Wroughton, *Journ. Bomb. Nat. Hist. Soc.*, xxvii, pp. 665-669, 1921.

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November 21st, the other on November 25th, both being in perfect coat.

a. Head, nape and shoulders yellowish olive in general tint, the hairs clearly annulated with bright yellowish buff, ashy grey at the base; the back brighter and yellower turning to orange on the loins and almost fiery red on the outside of the thighs, the basal half of the hairs on the bright red areas being white and the distal half red and not annulated. Tail like the rump at its base, greyish olive terminally. Arms grey, with yellowish buff speckling giving an olive hue. Legs washed with bright yellow, paling from the thigh to the foot which is greyish yellow. Some black hairs on the brow and close to the face; cheeks speckled, a little lighter than the top of the head. Under side mostly white, slightly reddish on the belly.

b. Much darker. Head, nape and shoulders deep greyish olive in general tint, the hairs annulated with pallid greyish buff, deeper smoky grey at the base; the back yellower olive, the lumbar region being like the head and nape of the other specimen. Buttocks and outside of thighs not nearly so fiery, the red being less bright and smaller in extent. Tail much darker. Arms a little darker, with grey ticking, hands blacker. Legs, feet and underside very much as in the first specimen.

Here and there occur specimens which are rich rusty red all over the dorsal surface from the head to the rump, although brighter behind than in front. One of this type, an adult female, was secured by A. C. Miller on January 2 in the Dangs, Surat District, associated with another not quite so red and with a young one much duller in tint, yellowish olive in front and not so bright behind. Quite as red as the first is a specimen from Dharmasala 4,500 ft. in the Punjab, shot by H. W. Wells on February 2; and even redder than these is a specimen secured by the same collector at Boska Nadi, N. Kamrup, 2,000 ft., on January 5, 1920.

Another variable character in these monkeys is the length of the tail as attested by the table of measurements given below.

SEASONAL CHANGES IN THE COLOUR AND LENGTH OF THE COAT

In the paper I recently published on the Bonnet Macaque (*Macaca radiata*) of South India, I showed that the coat is at its best, so far as colour is concerned, in the winter months, that it gradually fades through the spring and has a shabby and dead look just before the moult, which occurs in June or July.

The same series of phenomena takes place in *M. mulatta*. In the winter from about November to January the coat is perfect in colour and texture as described in the case of the two examples from Rajapara in South Kamrup, shot at the end of November. It is then soft in texture, the long hairs overlapping each other so as to conceal the grey tint of their basal portions.

There is some evidence that the coat may go on increasing in length during the early months of the year and that fading may set in towards the end of February. For example, a female shot

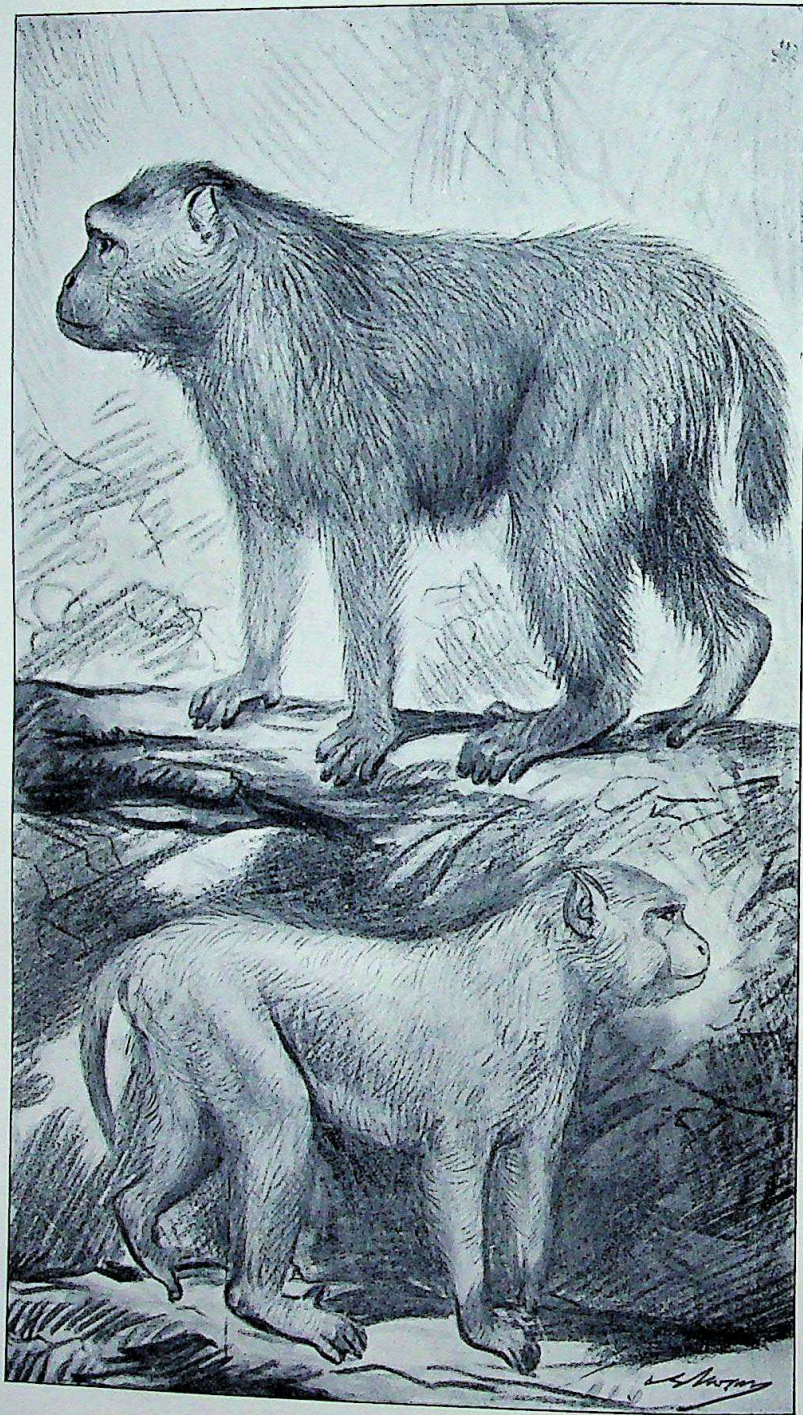
on January 9 by Baptista at Hasimara, 600 ft., in Bhotan Duars, which is almost exactly like a male he shot 2 miles W. of Gorkha, N.-W. Nepal, on December 7, is shorter in the coat and much more brilliantly coloured than a male shot at Bharnabhavi, 600 ft., Bhotan Duars, on February 21. These differences may, however, be independent of season, because the Bharnabhavi specimen very closely resembles the darker of the two specimens (b) shot in South Kamrup on November 25 and a male shot by J. M. D. Mackenzie 20 miles S.-W. of Kindat in Upper Burma on January 3rd.

Through March, April, May and June the coat gradually loses its lustre, softness and colour, the hairs tend to become uniformly tinted buffish or brownish grey and to adhere loosely in irregular bands or patches displaying the greyer hue of their basal portions. It then exhibits a shaggy, streaky appearance and is decidedly harsh to the touch. When remnants of the old coat are found in places after the new coat is up, the hairs are all uniformly greyish without a trace of buff in them. I am inclined to think that their distal, originally annulated ends break off from brittleness.

The moult is not exactly coincident in time even in the same locality, and no doubt varies still more with altitude or latitude in accordance with the earlier or later onset of warm weather. In two specimens, for instance, shot at Samyala, Kangra, 5,000 ft., by H. W. Wells on May 9, although the coat is long, shaggy, streaky and obviously faded in both, in one only has the moult set in as shown by a large median cap of new short hair on the forehead. This area appears to be always the first to clear. It is the only part that is cleared, for example, in a male with a faded shabby coat, shot at Kakara in Damoli, 1,200 ft., by Crump on May 12; and in another male shot by Shortridge on June 6 at the Mamsano Falls of the Nano Sao River, 2,000 ft., in the North Shan States.

From the evidence of other specimens it seems that the moulting of the forehead is followed by that of the extremities and the tail. A faded, shabby coated specimen, for instance, secured by Baptista on June 15 at Bouzini in Nepal has the forehead, feet and tail covered with quite short fresh hair. The tail, it may be added, in this and similar cases is exactly like that of the Pig-tailed Macaque, *M. nemestrina*.

In several cases in which the crown and feet are covered with short new hair while the rest of the body still carries the old, faded, shabby coat, the new hair of the dorsal surface can be detected beneath the old. This is clearly illustrated by a male example shot on June 15 at Patriata, Murree, 7,150 ft., by H. W. Wells. Here the long, shaggy hairs, sooty grey on the back of the head, the nape and shoulders and tipped with rusty brown on the loins, are everywhere underlain by the new short coat which is annulated reddish and black. A very similar condition of the coat is exhibited by two Burmese examples from Tatkon, 250 ft., near Kindat on the Upper Chindwin River, shot by G. C. Shortridge on July 5, and from Mingun in Upper Burma shot by the same collector on July 12. These three specimens suggest that the moult



UPPER FIG.—McMahon's Rhesus (*M. mulatta mcmahoni*) from Chitral.

LOWER FIG.—Common Rhesus (*M. mulatta mulatta*) from Bhotan Duars.

is later in Burma than in the Western Himalayas. However that may be, the moult is usually completed by August although in one specimen obtained by C. A. Crump on August 1 at Luia, Chaibassa, about 250 miles west of Calcutta, some of the old hair, lustreless and dull grey in hue, is still retained on the back. A still later date for its retention is attested by an example from Lamsakhang in the Cachar Hills shot on September 10.

One or two of the specimens from Upper Burma collected by Shortridge and Mackenzie in that country have already been referred to. In connection with these, I must add that a splendid series, ranging from Hkamti in the north to Prome and Toungoo in the south, was obtained by these collectors at various months of the year, mostly in the summer. These, with the exception of one probably wrongly-dated skin, bear out the conclusions regarding the moult and colour-change described above.

I have been quite unable to find any external character by which these Burmese specimens can be distinguished from specimens of typical *mulatta* from India.

THE LOCAL RACES OF THE RHESUS

Since several subspecies of *M. mulatta* are, in my opinion, admissible, it is necessary to fix upon one of them as the typical form to carry that name. The selection is narrowed by Pennant's statement that the living individual he described as the Tawny Monkey, which Zimmerman named *mulatta*, came from India; but it may have been captured near Bombay or Calcutta or in one of the hill-stations. For the specimen described by Buffon, the type of *rhesus*, *fulva* and *erythræa* which are synonyms of *mulatta*, no locality was given. But for the monkey represented by the synonym next in order of date, namely *oinops* Hodgson, 1843, a definite locality, the Nepal Tarai, is known; and since I concur with Anderson, Blanford, Hinton and Wroughton in considering *oinops* the same animal as *mulatta* (*rhesus*), I propose to regard the Nepal Tarai as the locality of the typical race.

THE COMMON INDIAN AND BURMESE RHESUS

Macaca mulatta mulatta, Zimm.

Macaca mulatta, Zimm., 1780; *fulva*, Kerr, 1792; *rhesus*, Aud., 1798; *erythræa*, Shaw, 1800; *oinops*, Hodgs., 1840; Hinton and Wroughton, *J. Bomb. Nat. Hist. Soc.*, xxvii, p. 665, 1921.

Pithecus brevicaudus, Elliot, *Rev. Prim.*, ii, p. 216, 1913.

Macaca siamica, Kloss, *J. Nat. Hist. Soc., Siam*, ii, p. 247, 1917.

To the synonymy of this race published by Hinton and Wroughton I have added, for reasons given below, the last two names on the list.

The range of variation in the colour of this race is practically covered by the descriptions given above of the two examples from Rajapara in South Kamrup.

The following notes on some specimens referred to this race may be interesting.

Nagarcot, Nepal, 8,000 ft. (R. L. Kennion). October 15th. An adult female, colour very much as in Rajapara *a*. The coat is soft and short, barely 2 inches on the shoulders despite the altitude which is considerably above that of any other specimen in the collection. It is shorter than in October skins of *villosa* from Kumaon at much lower elevations. The head and body are 1 ft. 9 ins., the tail 9 ins.

Chengli, Ghorkha, W. Nepal (N. A. Baptista). December 7. A male skin, redder than the last, with a softer fuller coat, the hair on the shoulder about 2½ ins.

Hazaria Pathergatta, the Nepal Tarai, 600 ft. (N. A. Baptista). February 17. A toptype of *mulatta* as indicated by *oinops*. The colour almost identical with that of Rajapara *a*. The winter coat is neither wavy, woolly nor particularly thick, the hair on the shoulders being a little over 2 ins.

Bouzini, the Nepal Tarai, June (N. A. Baptista). The moult is just setting in and the old discoloured woolly winter coat measures about 2 ins. on the shoulder.

Bharnabai, 600 ft., and Hasimara, 600 ft., in the Bhotan Duars (N. A. Baptista). Several specimens varying considerably in colour and intergrading completely in tint between *a* and *b* of the Rajapara pair. In a male from Hasimara, January 1, the coat is only about 2 ins. on the shoulder; in one from Bharnabai, February 21, it is nearly 2½ ins. Two ♀ from Hasimara, January 8, are softer coated than the ♂. The Bhotan Duars are similar in physical features to the Nepal Tarai.

Bogra Nadi, 2,000 ft., N. Kamrup (H. W. Wells), Jan. 5. A young well-coloured ♂ with soft thickish fur but the hair only about 1½ in. long.

From comparatively low-lying country south of the Ganges the Survey unfortunately secured only a few specimens which seem referable to this race.

Luia, Chaibassa, 1,000 ft. (C. A. Crump), Sept. 1. Two young specimens above referred to as just free of the old coat, the new coat being very short and sleek.

Sohagpur, Hoshangabad, 1,000 ft. (C. A. Crump), April 10, ♂ adult. The winter coat still retained but shabby, streaky and faded, dull grey, with pallid buff tips to most of the hairs on the fore part and washed out orange on the rump. The cheeks, feet and tail below are white and the hands nearly so. The hair on the shoulders is from 2 ins. to 2½ ins. in length.

Kokara, Damoh, 1,200 ft. (C. A. Crump), May 12, ♀. Colour and coat much as in the last but new coat appearing on the forehead; the colour rather darker, the cheeks, hands and feet and lower side of tail not white.

Dangs, Surat, (C. A. Miller), Jan. Three flat ♀ skins. The coat is soft and thickish and about 2 ins. long. The colour, as pointed out above, is individually very variable.

In Assam H. W. Wells procured specimens from the following localities:—Nangpon, Khasia Hills, 1,200 ft.; Lamsakhang, Cachar,

200 ft.; Golaghat, Dening in the Mishmi Hills, 2,250 ft. These specimens show no distinctive characters; and the same is true of examples collected by Messrs. G. C. Shortridge, S. A. MacMillan and J. M. D. Mackenzie at the following localities in Burma:—Hkamti, Homalin, Tamanthe 460 ft., Kindat 600 ft., Tatkon 200 ft. in Upper Chindwin; at Yin, Alichia in the Chin Hills 1,000 ft. in Lower Chindwin; Pyaungyaung 2,790 ft., Mamsano Falls, Nano Yao River, 2,000 ft., Seen Hsipaw State 410 ft. in the Northern Shan States; and farther south at Mt. Popa, to the east of Toungoo, 100-500 feet; and 30 miles S.-E. of Prome, 800 ft.

The most southern localities for typical *mulatta* in Burma on this list are Toungoo and Prome. How much farther south the animal extends is unknown; but it is not found in Tenasserim.

To the east of the Shan States in Northern Siam this race also occurs. At all events C. B. Kloss gave the name *Macaca siamica* to an adult male example collected at the Me Ping rapids, below Chiengami, 850 ft., (*Journ. Nat. Hist. Soc. Siam*, II, p. 247, 1917), and I cannot find either in the description of the skin or the measurements of the skull a particle of evidence to justify the admission of *siamica* as a symbol even of a local race of *M. mulatta*. But Kloss's acquaintance with the macaques of this group was practically restricted to Elliot's *Review* which has only a bibliographical value. Kloss drew attention to certain particulars in which the Siamese skull differs from the figures of the skull of the Hainan rhesus published by Elliot. But the two skulls are very different in age, the one from Hainan being much younger with the sutures of the upper side very clearly defined, whereas in the Siamese skull all the sutures, according to Kloss, are obliterated.

I have seen no examples actually from Siam; but farther eastward, in Annam and Tonkin, Delacour and Lowe, met with this monkey and sent three females to the British Museum.

The Tonkin specimens were taken at Bac Kan, 500 ft., on December 13 and 24. They are therefore in perfect colour. One of them is practically indistinguishable from some examples of *mulatta* from Hazaria Pathergatta in the Nepal Tarai and from Hasimara in the Bhutan Duars described above; but the base of the hair is more sea-gull grey, and the tail is fuller.

The second specimen is distinctly darker, the hairs being more sooty-grey basally, with the pale annuli on the fore part and the rump more rusty. The tail is not so bushy.

The Annam specimen taken at Phua-a-Qui, 100 ft., on February 28th is not nearly so bright as the foregoing, the fore quarters being more olive and the rump is less red. It is not so red behind as a ♀ from the Bhutan Duars but is almost identical in colour with it on the fore parts.

I am unable to distinguish these skins from Indian specimens referred to *M. mulatta mulatta*.

The same must be said of examples from Hainan. Swinhoe was the first apparently to record the existence of a Rhesus-like monkey in Hainan (*Proc. Zool. Soc.*, 1870, p. 226). He quite correctly identified it as *Macacus erythræus*, one of the many names given

to the Rhesus; and one of his specimens, a young male, killed in March 1868, was presented to the British Museum.

Subsequently several specimens were acquired from Mt. Washi on the island by the American Museum of Nat. Hist., New York. Elliot got hold of these and described them as representing a new species under the name *brachyurus* (*Ann. Mag. Nat. Hist.* (8), iv, p. 251, 1909) which, on account of its preoccupation¹, he altered afterwards to *brevicaudus* (*Rev. Primates*, ii, p. 216, pl. xxiii, 1913.). He wrote with assurance about the distinctness of this monkey from the Indian *rhesus*, claiming its tail to be much shorter and its colouring much brighter. He also laid particular stress on some cranial features; but since there seems to be no doubt that he compared his skulls from Hainan with abnormal skulls of *mulatta* reared in captivity, of which there are many in the British Museum, where he was working at the time, the skull characters he mentioned have no value.

The measurements² he quoted for the skin, give the head and body as 510 mm. ($=20 \frac{2}{5}$ ins.) and the tail as 220 mm. ($=8 \frac{4}{5}$ ins.), the tail being considerably longer than the foot and between one-third and one-half the length of the head and body. There is nothing unusual about the dimensions. The actual measurements, indeed, of the type of *brevicaudus* coincide very closely with those of a male, collected at Damoh in the C. P. of India, in which the head and body are 515 mm. and the tail 218 mm., the tail being a trifle shorter in proportion than in *brevicaudus*. But, as has been shown, the length of the tail is very variable in these monkeys. And Elliot's statement that the colour of the Hainan rhesus is much brighter than in the typical Indian form, is entirely unsupported by the facts known to me. At all events, the two specimens of it that I have seen are duller in tint than most of the Indian specimens, the topotype being almost as close a match as it is possible to imagine with the two examples from Chaibassa, to the west of Calcutta, which must be assigned to typical *mulatta*.

The two Hainan specimens in the British Museum show certain differences in colour, no doubt mostly, if not wholly, seasonal. In the topotype of *brevicaudus* collected on October 10, when the coat was almost fresh, it is tidy, comparatively short and the hairs of the head, neck and fore-part of the body are annulated with yellowish buff and blackish grey, the general effect being olive at a distance; and the hind quarters have but little brightness about them. Swinhoe's specimen, shot in March, has, on the contrary, the coat distinctly longer and rougher, the hairs on the fore quarters being curled and dead at the tips and exhibiting very inconspicuous annulation. The arms also are browner and the under side a less dusky grey. The made-up skin measures: head and body 15

¹ By Hamilton Smith (*Jardine's Nat. Libr.*, i, p. 103, pl. i. 1842), who gave the name to an albino macaque with a very short tail. Elliot put *brachyurus* amongst the synonyms of *nemestrinus*; but obviously quite without justification, the tail of *brachyurus* being much too short for *nemestrinus*.

² Presumably these dimensions were taken in the flesh by the collector. But a topotype received from the American Museum and presumably one of the specimens Elliot examined, has no measurements, nor is there any provision on the collector's label for them.

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inches, tail 7·1 inches, and the hind foot 4·5 inches, the proportions being about the same as in Indian specimens.

The following table gives the principal dimensions, taken in the flesh in English inches of specimens ranging from Central India to Tonkin.

Locality & Sex		Head & Body	Tail	Hind Foot	Weight
Hazaria Pathergatta, Nepal Tarai.	♂	21·6	10·4	6·4	16½ lbs.
Ghorkha, Nepal,	♂	20·8	10	6·4	
Rajapara, S. Kamrup,	♂	21·6	9	5·6	
Hasimara, Bhotan Duars,	♂	19	8·8	6	
Damoh, C. India,	♂	20·6	8·8	6·2	15½ lbs.
Mingun, Upper Burma,	♂	22	8	6·4	
Homalin, Chindwin,	♂	23	8·4	5·8	
Mamsam Falls, N. Shan States,	♂	21·4	8·2	6·3	
Siam (<i>siamica</i>).	♂	19·8	9·4	5·4	11½
Chaibassa, Bengal. Young	♂	14·4	9	5·3	
„ „ Young	♀	16	7·2	5·6	
Nagarcot, Nepal,	♀	21	9	6·3	
Narbong, Darjiling,	♀	20·2	8·4	5·6	11
Hasimara, Bhotan Duars,	♀	17·6	9	6	
Sohagpur, C. India,	♀	18·6	8·5	5·8	
Mishmi Hills,	♀	19·2	11·2	5·8	
„ „	♀	16·4	9·6	5·7	13
Kindat, Upper Burma,	♀	17·2	9·6	5·7	
Pyaungyaung, N. Shan States,	♀	20	7·4	5·4	
Tonkin,	♀	20·8	8·4	5·8	
„	♀	19	8	5·6	11
Annam,	♀	18	7·6	5·8	

This table shows tolerably close agreement in size between specimens assigned to this race; but it somewhat surprisingly reveals very little difference, except in weight, between the males and the females.

The tail, it will be noticed, although always longer than the hind foot, is very variable, occasionally over one half the length of the head and body, but usually between one half and one third. I have inserted the dimensions of two young specimens from Chai-bassa to illustrate its individual variation in examples from the same locality.

The following are the principal cranial dimensions¹ of a few specimens assigned to *M. mulatta*.

Locality and Sex	Skull in inches.					Teeth in Millim.		Remarks
	Total Length	Zygomatic Width	Orbital Width	Width of Maxilla	Length of Mandible	Upper Cheek Teeth	1st Upper Molar	
Nepal, ♂	4.4	2.9	2.5	1.6	3.1	31	8 x 8	One of Hodgson's examples of <i>sinops</i> .
" ♀	4.5	...	2.6	1.6	3.3	31	8 x 8	
" ♂	4.7	...	2.7	1.6+	3.4+	34	8 x 8	Type of <i>siamica</i> , Kloss. B. H. Hodgson. Labeled <i>sinops</i> . Old ♀.
Bhutan Duars, ♂	4.8	3.3	2.5	1.6	3.4	35	9 x 8	
" ♂	4.5	3.3	2.5	1.5	3.2	33	8 x 8	
Chittagong, ♂	4.8	3.2	2.6	1.5+	3.4	32	8 x 7	
Kindat, Upper Burma, ♂	4.7	3.3	2.7	1.6	3.5	33	8 x 7	
" ♂	4.8-	3.2	2.6	...	3.5	31+	...	
Nepal, ♀	4.2	3	2.4	1.4+	...	34	8 x 8	
Darjiling, ♂	4.2	3	2.5	1.4	3	30	8 x 8	Prof. Oldham. Old ♀.
Bengal, ♂	4.3	3.1	2.6	1.6	3.1	32	8 x 8	
Dangs, Surat, ♂	4.1	2.7	2.3	1.5	3	27	8- x 8-	
Mishmi Hills, ♂	4.3	...	2.5	1.5	3.2	30	8 x 8	
H'Kamti, Chindwin, ♂	4.1	2.8	2.3	1.3	2.8	28	7 x 7	
Backan, Tonquin, ♂	4.5	3.2	2.6	1.6	3.3	29	7 x 7	
Phu Qui, Annam, ♂	4.3	3.1	2.7	1.6	...	33	8 x 8	
" ♀	4.3	2.9	2.4	1.5	2.9+	30	7 x 7	

¹ Here and elsewhere in this paper the width of the maxilla is taken just above the 1st molar, the penultimate cheek tooth. The cheek teeth are those behind the canine.

Although the male skulls in this list agree tolerably closely in dimensions, no two are precisely alike, the individual variation in the roundness of the crown, the prominence of the occiput and of the jaws, the length from the brow to the nares and the degree of concavity of the interorbital and nasal bones, being very considerable. It may be noted that Kloss's type of *siamica* is in close agreement with examples from Bhutan Duars and Chittagong.

The female skulls are almost equally variable, a good illustration being supplied by the three from Tonkin and Annam collected by Delacour and Lowe. The first of these is a little larger than any of the Burmese or Indian specimens. This is partly due to the prominence of the occiput. The second, an older animal, from the same locality, has the occiput much less produced, the maxilla much less pinched, the brows less prominent, the nasals much narrower and the teeth much larger. The Annam skull has such prominent brows that the interorbital septum is nearly vertical. In this as in other respects, except the smaller teeth, it closely resembles the Bengal skull (Prof. Oldham). They might, indeed, be sister-skulls.

THE RHESUS OF KASHMIR AND KUMAON

Macaca mulatta villosa, True.

Macacus rhesus villosus, True, *Proc. U.S. Nat. Mus.*, xvii, p. 2, 1894.

Pithecus villosus, Elliot, *Rev. Prim.* ii, p. 200, 1913.

Locality of type: Lolab at the northern end of Wular Lake, about 40 miles N.-W. of Srinagar in Kashmir.

Distribution: Southern Kashmir, Upper Punjab, Kumaon.

The original specimens of this monkey, collected by Dr. Abbott, were shot on September 8th and 9th, from four to six weeks after the completion of the moult when the coat should be comparatively short. But True described it as 'long, dense, and moderately wavy', and Elliot as 'long, loose and woolly'. Otherwise there is nothing in the description of this monkey, apart from a slightly larger skull, to distinguish it from the typical Rhesus.

Through the kind offices of Mr. Gerrit Miller junr., I have received on loan from the Smithsonian Institution, two of the specimens, an adult and a young male, described by True and Elliot. The coat in general is most emphatically neither long, loose, wavy nor woolly, but is short, close and smooth as in the normal new pelage of the Rhesus, although it is a little longer on the limbs, especially on the toes, in both examples and on the head in the smaller. The colour is a little redder and brighter than in average typical *mulatta*, the tail darker above and the hands and feet dusker; but the differences in the skins amount to very little.

Before examining these specimens, I had identified as *M. mulatta villosa* a fine series of Rhesus skins in the British Museum mostly obtained by the Mammal Survey, from tolerably high altitudes in the Himalayas, Kangra, Kumaon etc.

Of this series, one already historical, may be disposed of first. It is a female received from the Zoological Society in 1871 and

labelled Kashmir. But according to Anderson it was purchased at Delhi or Agra from a native who stated it came from Kashmir, which is, of course, no proof that it did. (*Zool. Res. Yunnan*, p. 73, 1878). Elliot subsequently got hold of this specimen and thinking it belonged to the Macaque from Fokien in Eastern China which he described as *Pitheculus littoralis*, stated that the animal was 'evidently erroneously attributed to Cashmere' (*Rev. Prim.* ii, p. 202¹). I have no doubt that the monkey came from Kashmir. In tint the skin generally resembles that of typical *mulatta* and is well coloured; but the coat, although not exceptionally long is remarkably thick, woolly and close. On the toes the hair overlaps the long claws by $\frac{1}{2}$ an inch. In the made-up skin the head and body are about 18 $\frac{1}{2}$ ins., the tail, without the hair, about 9 $\frac{1}{2}$ ins., and the hind foot, although shrunk, about 5 ins. Since the skull is very young, without trace of true molars, the dimensions of the skin indicate a large monkey.

The Survey secured examples at the following localities:—

Patriata, Murree, 7,150 ft., (H. W. Wells). An adult male shot on June 15th. This specimen has already been alluded to in connection with the moult. The old, long, shabby, discoloured winter coat is everywhere being replaced by new characteristically annulated hair.

Dharmasala, Punjab, 4,500 ft., (H. W. Wells). A young male shot on February 5. Very like the female from Kashmir and nearly as bright as Abbott's examples. A well-coloured skin, with considerable amount of red, in perfect coat, the hair long, between 2 $\frac{1}{2}$ and 3 ins. on the shoulders, loose and beautifully soft, dark grey basally, red at tips. No measurements taken.

Samyala, Kangra, Punjab, 5,000 ft., (H. W. Wells). Two males shot on May 9th. A couple of shaggy skins with the moult imminent. In one the coat is shorter but considerably more curly than in the other. There is hardly a trace of red on the fore quarters, the general hue being dark greyish brown, but the red of the thighs and loins is retained although faded. In the dusky hue of the hands and feet and of the upper side of the tail, the larger of the two closely resembles True's *villosa*.

Kangra Fort, 2,450 ft., (H. W. Wells). An adult male shot on March 18. Coat loose but very long, about 3 $\frac{1}{2}$ ins. on shoulders where the hairs are palish grey basally and with the tips already beginning to fade and curl; otherwise the colour is fairly normal although not nearly so dark and rich as in the example from Dharmasala.

Bageswar in Kumaon, 3,200 ft., (C. A. Crump). Two males and a female shot on October 1st and 3rd. These skins are decidedly longer in the coat than Dr. Abbott's specimens, but not so brightly coloured, the annulations being less distinct on the fore quarters and the red not so bright behind. Possibly the difference is due to the later season. The female is duller, more olive in tint.

Ratighat, Naini Tal, Kumaon, 3,700-3,800 ft., (C. A. Crump). A pair collected on November 1 and 5. The colour is as in the

¹ An error Elliot fell into as a result of this mistaken identification is explained (*vide p. 546 infra*) in connection with the Chinese race.

female from Bageswar and not so bright as in the males; and in the male the hair is much paler at the base, white on the hind quarters. The coat is long, $2\frac{1}{2}$ ins. on the shoulder but not so thick.

Sitabani, Ramnagar, Kumaon, 2,000 ft., (C. A. Crump). Two males shot on November 22. Both are very well coloured, one of them being hardly distinguishable from Abbott's Lolab specimens but the coat is not so full and is greyer at the base of the hairs.

Dela Ramnagar, Kumaon, 1,500 ft., (C. A. Crump). A male shot on January 7. The coat is loose and long, 3 ins. or more in length and well coloured and annulated, but paler than in the Lolab specimens and with much less under fur, the base of the hair being paler ashy grey. It is not nearly so brightly coloured as in the Sitabani examples. As in them the measurements indicate that it is immature.

The following are the flesh measurements and weights of a few specimens:—

Locality and Sex	Head and Body	Tail	Hind Foot	Weight
Satriata, Murree, ♂ ...	25	12	7	...
Pamyala, Kangra, ♂ ...	23	10	6.7	...
" " ♂ ...	20.5	10.5	6.5	...
Kangra Fort, ♂ ...	20	12.5	6	...
Bageswar, Kumaon, ♂ ...	22	11.5	6.8	22 lbs.
" " ♂ ...	21.8	9.5	6.8	23 "
Ratighat, Naini Tal, ♂ ...	20.5	9	6.5	17½ "
Bageswar, Kumaon, ♀ ...	18.5	8.6	5.8	14½ "
Ratighat, Naini Tal, ♀ ...	19	10	5.6	13 "

These particulars indicate a heavier and on the average a slightly larger monkey than typical *mulatta*; but the differences are not very marked and there is no doubt that *villosa* intergrades with *mulatta* at the lower levels. The individual variation in the length of the tail as compared with the head and body and the foot is very considerable, as in typical *mulatta*.

The largest skull of this race in the British Museum is that of the male example from Murree. It is a little smaller than the skull of the type from Lolab; but the more open sutures indicate a younger animal with the skull probably not quite full sized. This is also indicated by the lighter mandible with lower ascending ramus. It also has the muzzle narrower and the brow-ridge in profile higher; but otherwise the skulls are unmistakably alike. The same applies to the skulls from Kangra and Kumaon, although no two are exactly alike in all characters. Except that these skulls are larger than those assigned to typical *mulatta* and on the average have deeper muzzles, more pronounced brows, and the temporal ridges in the adult closer together, although never actually joined, they are naturally very like those of the typical race.

It is interesting to note that the skull of a male Rhesus, ticketed Chunar, Benares, in the Museum Collection is *villosa*-like in form but is smaller and has an exceptionally short tooth-row.

In the following table of cranial measurements of examples of *villosa*, all actually approximately full-sized, are included those of the type of the Chitral race described below.

The skulls of *villosa* are decidedly a little larger on the average than those assigned to *mulatta*.

Locality and Sex		Skull in inches.					Teeth in Millim.		Remarks
		Total Length	Zygom. Width	Width across Orbits	Width of Maxilla	Length of Mandible	Upper Cheek Teeth	1st Upper Molar	
Chitral,	♂ ...	5.7	3.8+	3.2	1.9	4.1+	36	9 × 9	<i>M. m. menahoni</i> Type.
Lolab,	♂ ...	5.4	3.8	3.1	1.7	3.9	35	9 × 9	" " <i>villosa</i> Type.
Murree,	♂ ...	5.2	3.7	2.9+	1.6	3.8	35	9 × 9	" "
Kangra,	♂ ...	5.2	3.6	2.8	1.7+	3.7+	34	9 × 9	" "
Bageswar, Kumaon,	♂ ...	5.1	3.6	2.8+	1.5	3.7	35	9 × 8	" "
Ratighat, Kumaon,	♂ ...	5.0	3.6	2.8	1.6	3.6	33	9— × 8	" "
Benares,	♂ ...	5.0	3.6	2.8	1.6	3.6	30	8 × 8	" "
Ratighat, Kumaon,	♀ ...	4.4	3	2.5	1.5	3+	31	7 × 8	" "
Bageswar, Kumaon,	♀ ...	4.4	3.2	2.5+	1.5+	3	30	8 × 8	" "
"	♀ ...	4.2	2.9	2.4	1.4	3	30	7+ × 7+	" "

THE RHESUS MONKEY OF KAFIRISTAN AND CHITRAL.

The earliest reference apparently to this monkey was made by Captain H. G. Raverty when he wrote:—'In some of the warmer parts of Kafiristan, in the densely wooded districts, monkeys of the largest size are found, but are not very numerous'. (*Journ. As. Soc., Bengal*, 28, p. 332, 1859). Blanford, who assumed this record referred to the Himalayan Langur, doubted the truth of it when he declared it 'requires confirmation' (*Mamm. Brit. India*, 1888, p. 30). But since Captain Raverty was writing of his own knowledge, Blanford's scepticism was perhaps a little uncalled for.

At all events, the correctness of Raverty's statement was established later by Sir Henry McMahon, G.C.V.O., G.C.M.G., K.C.I.E., who reported:—'Monkeys are to be found in the lower end of the Chitral Valley. Captain Gurdon saw a herd of them at Mirkandi on the bank of the Chitral river only 4,000 ft. above sea-level. The general characteristics seem to be those of *Macacus rhesus*, but all the specimens I have seen have, instead of a tapering tail, a tail of about 8 ins. coming to an abrupt end as if cut off like a fox terrier's'. (*Journ. As. Soc., Bengal*, 70, pp. 4-5, 1901). Subsequently in 1906 he procured an adult female for the Zoological Gardens and told me he was convinced of its distinctness from the ordinary Rhesus of India. It was certainly darker and thicker-coated; but close inspection of the living animal was impossible, and even after its death in 1910 I could not satisfy myself that it differed from the Kashmir race, *M. mulatta villosa*, which was known to me only from the very misleading description published by True in 1894. In reply to my inquiry, made in March this year, regarding the exact locality of this individual and the occurrence of the Rhesus in Kafiristan, Sir Henry McMahon wrote to me:—'The place where I saw a herd of these monkeys in a wild state and from where the Zoological Society's specimen came is in that part of Kafiristan which juts into the south-west portion of the Chitral State.'

Captain H. Fulton also observed this Rhesus in Chitral and, dissenting from McMahon's view of its distinctness, cited it as *Macacus rhesus* and recorded it as 'Very plentiful at the lower end of the Chitral Valley in summer on the right bank of the river. They come up as far as the Utzun Valley in troops at 5,000 ft. and probably come over the pass into Utzun from Kafiristan Valley.' (*Journ. Bomb. Nat. Hist. Soc.*, 14, p. 758, 1909).

When revising the 'Survey' specimens of the Rhesus in the British Museum, I came across the skin and skull of an adult male shot by Captain F. D. Stirling early in February at Kootai in Lower Chitral between the Bashgal Valley in Kafiristan and the Chitral Valley, 3,600 ft. alt. This specimen, represented by the skin and skull, had been identified by Wroughton as *villosa*. But since it differs from *villosa*, its nearest ally, in certain characters, I propose to describe it as a new subspecies dedicated to Sir Henry McMahon who from the first was convinced of the distinctness of the Chitral Rhesus.

Macaca mulatta mcmahoni subsp. nov.

Locality of type: Kootai in Lower Chitral, between the Bashgal Valley in Kafirstan and the Chitral Valley; 3,600 ft.

Distribution: Kafirstan and Chitral.

Description of Type: Coat extremely long, thick, shaggy, loose and wavy but silky in texture. Colour of head, shoulders and fore-back deep greyish olive, the hairs dark grey with tips very indistinctly annulated with buff, sufficient only to give a yellowish green wash over the grey; the hind-back brown, the annulations being a little brighter and more extensive, so that the grey of the hair, which is here lighter, is less in evidence. On the rump, which is redder, the hairs are more silvery grey with the outer half rusty yellow. This tint is continued on to the upper part of the thighs and the basal third of the tail; but the rest of the outer side of the leg is grey with a yellowish wash, the feet being a little browner; and the thickly haired tail gradually turns to a dark brownish grey towards the end. The arms, which are long haired to the elbow, and the hands are a deep almost blackish grey, with minute annulations only just perceptible. The crown of the head is blackish olive, with no perceptible speckling; the long hairs of the cheeks are grey with dark and paler annulations, and the whole of the under side, the inner side of the limbs and even the lower side of the tail are uniformly pale greyish white.

No measurements in the flesh were taken; but the dimensions of the dried skin are: head and body 1 ft. 11 ins., tail $9\frac{1}{2}$ ins., hind foot $6\frac{1}{5}$ ins.

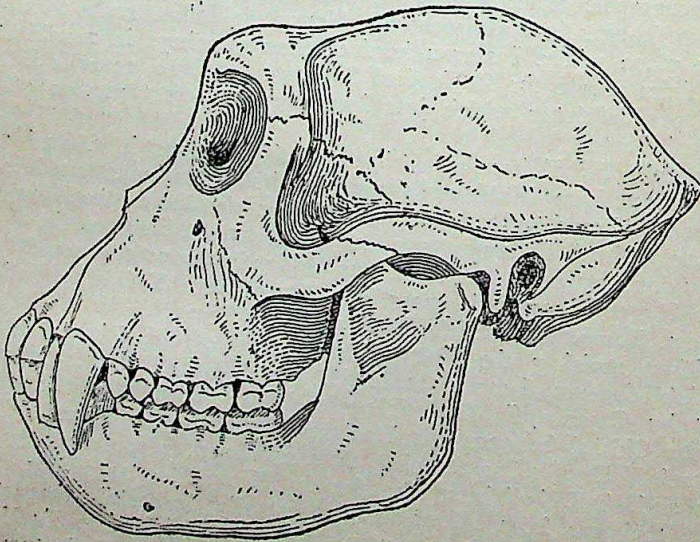


FIG. 1. (a) Skull of *M. mulatta mcmahoni* from Chitral.

Shot at the beginning of February, this specimen has the winter coat in full development and in no respects deteriorated. In the

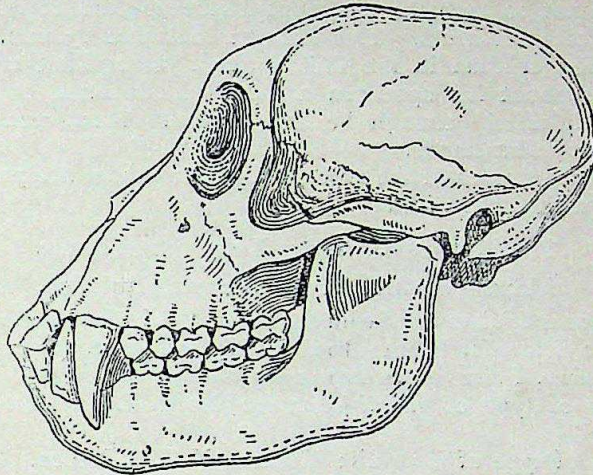


FIG. 1. (b) Skull of *M. mulatta mulatta*, male of about the same age from Bhotan Duars.

looseness and length of the coat of which the hairs on the shoulders measure up to 4 ins. (100 mm.) in length, and in the general darkness of its hue, the skin differs strikingly from those of typical *mulatta* and of *lasiotus* killed in the same month of the year. The colour, however, is not very different from that of the example of *villosa* from Murree shot on June 15 which still carries most of its winter coat; but the hairs are shorter and discoloured and the newly erupting coat shows that in mid-winter the monkey would have been conspicuously annulated with reddish buff all over the hind quarters.

In the female specimen brought from Chitral by Sir Henry McMahon, which died on January 19th, 1910, the coat is not so long, streaky or shaggy as in the male described above but is thick, comparatively smooth, full and longish everywhere, about $2\frac{1}{2}$ ins. (over 60 mm.) on the shoulders. The head and fore quarters are dusky olive and a little greener, less grey and rather more distinctly speckled than in the male; the head is not so dark on the crown but the cheeks are dark grey and unspeckled, darker close to the face; the arms are paler grey and unspeckled. The redness of the hind quarters is very much the same but is a little brighter and there is rather more colour on the outside of the legs and the top of the feet where the hairs are long and overlap the nails. The colour of the under side differs in the pallid rusty hue of the abdominal hairs. The measurements of the made-up skin are: head and body 1 ft. $9\frac{1}{2}$ ins., tail $8\frac{1}{2}$ ins., hind foot (stretched) $5\frac{3}{4}$ ins.

This skin is decidedly less brightly coloured and duskier olive on the fore quarters than average examples of *M. m. villosa*; but some of the duller specimens of the latter approach it in those respects.

The skull of the male specimen of *mcmahoni*, although youngish and probably not quite full-sized, is decidedly bigger than the

average skulls of *villosa* and in addition has the brows much better developed. It is the largest skull of the Rhesus group that I have seen; but not so large as the reputed Rhesus-skull of which Elliot gave the measurements. This has the mandible 13 mm. (about $\frac{1}{2}$ an inch) longer than in the Chitral skull. But Elliot supplied no particulars about his specimen and his identification of it carries no weight. Likely enough he had a skull of *m. assamensis* or *m. speciosa* in his hands.

The measurements of the type-skull of *mcmahoni* are published in the table with those of *villosa*.

THE RHESUS OF HONG-KONG AND FOKIEN.

Macaca mulatta sancti-johannis, Swinhoe.

Inuus sancti-johannis, Swinhoe, *Proc. Zool. Soc.* 1866, p. 555.

Pithecius littoralis, Elliot, *Ann. Mag. Nat. Hist.* (8), iv, p. 250, 1909; *id. Rev. Prim.*, ii. p. 201, 1913.

Locality of type of *sancti-johannis*: North Lena Island, Hong-Kong.

Locality of type of *littoralis*: Kuatun, N.-W. Fokien.

Closely resembling typical *mulatta* in colour but distinguishable from all the races hitherto considered by the shortness of the tail which is only a little longer than the hind foot. The skull, in the ♀ at least, is larger than in typical *mulatta*.

Swinhoe sent the type of *sancti-johannis* as a living animal to the Zoological Gardens whence it was transferred to the British Museum. Here it was examined by Anderson and Elliot who left its status unsettled on account of its immaturity. It is a young female, with milk dentition, and measures head and body about 300 mm. (12 ins.), tail 118 mm. (4.7 ins.), hind foot 107 mm. (4.2 ins.). But the length of the body is considerably shortened by a lateral curvature of the spine and contraction of the loins, both associated with rickets. Swinhoe recorded the length of the tail of the newly caught animal as $4\frac{1}{2}$ ins., which was no doubt approximately correct. But Anderson, who measured it on the specimen in alcohol, gave $5\frac{1}{2}$ ins. This is true with the hair at the tip included. From my measurements it will be seen that the tail is only 11 mm. longer than the hind foot; and to show that the shortness of the tail is not a juvenile character I subjoin particulars of the dimensions in millimetres of four young examples of typical *mulatta* from Burma:—

...	1	2	3	4
Head and Body	209	270	342	423
Tail	157	150	174	240
Hind Foot	88	101	114	137

In these and many more, from the newly born up to maturity that I have measured, the tail is always very considerably longer than the hind foot,

Swinhoe's specimen, now made up into a skin, was in full moult when it died. The winter coat, still adherent to the neck, shoulders, flanks and thighs, is long and soft, about 2 ins. long on the shoulders where the hairs are tipped with ochreous brown; on the thighs the tips are much brighter and redder. But the new coat which is fully exposed on the crown and the back from behind the shoulder to the root of the tail is unusually dark owing to the presence of a good deal of blackish pigment in the hair. The under side is buffy white.

The typical example of *littoralis* is an adult ♀ collected at Kuatun by C. B. Rickett in November 1898. A second specimen, a young ♂, was secured by J. de la Touche at the same place on May 12, 1898. Both are in the British Museum and both were seen by Elliot who detected the shortness of their tails but attributed it to injury. The tails are complete and supply the only satisfactory character substantiating the racial status of this form.

Elliot's description does not mention a single feature by which *littoralis* can be distinguished from *mulatta*. He, indeed, referred to it a third specimen in the British Museum received from the Zoological Society as coming from Kashmir. But he dismissed Kashmir as its locality because he thought the specimen belonged to the same kind as the two from Fokien. It does not. It is a thick-coated rhesus with a tail of ordinary length, no doubt came from the country assigned to it, and is practically certainly an example of *M. m. villosa* (cf. *supra*).

The two Fokien specimens exhibit great difference in colour. The female killed in November has the comparatively new coat smooth, of moderate length, with the characteristic reddish annulation on the hairs of the head and shoulders, becoming brighter posteriorly and turning to bright orange red on the outside of the thighs, the legs and feet being washed with yellowish red. The male, collected in May, has the coat still in good condition but considerably longer, rather shaggier and much more olive in hue than in the female. There is, indeed, unusually little red on the hind-back and the brightness of the thighs is buff brown rather than orange, and the lower legs are hardly visibly washed with yellow; but the scrotal hairs are red as in typical *mulatta*. The under side is greyer, less buffy white than in the type.

No measurements in the flesh were taken of these specimens and the dimensions of the head and body in made-up skins are apt to be misleading, owing to stretching. The tail, however, does not stretch to a great extent. In the two specimens the tails measure about 6 inches (150 mm.) and the hind feet, allowing for shrinkage with drying, are at most only a little shorter.

Apart from the very immature type-skull of *sancti-johannis* there are two skulls of this race in the British Museum, both of females and both presented by C. B. Rickett. The skull of the type is that of an adult, but youngish adult, specimen and possibly not quite full-sized. The other is younger. They seem to be a little larger on the average at all events than skulls of typical *mulatta* from India; but the difference does not amount to much. Individually they differ in one or two features worth recording. In the type

the orbital sockets are slightly higher than wide, the nose and muzzle are more compressed, the cheek teeth are straighter and the occipital protuberance more truncated. (For measurements, see table under *lasiotus*.)

THE RHESUS OF SZECHUEN.

Macaca mulatta lasiotus, Gray.

Macacus lasiotus, Gray, *Proc. Zool. Soc.*, 1868, p. 61, pl. vi; Anderson, *Zool. Res. Yunnan*, p. 83, 1878; Elliot, *Rev. Prim.*, ii, p. 198, 1912 (*lasiotus*).

Locality: Szechuen, S. China.

For many years the only known example of this Macaque was the typical, accidentally tailless,¹ specimen exhibited in the Zoological Gardens and sent to the British Museum in 1871. This was a full-grown male and was tolerably fully described by the authors above quoted, especially by Anderson who gave a figure of the skull with its structural peculiarities.

In 1911 a second specimen, an adult female, was collected by M. P. Anderson, for the Duke of Bedford's expedition, in the mountains 30 miles S. of Kia-ting, Sze-chuen, at an altitude of 2,900 ft. on a bush-covered precipice. This specimen was referred to by Thomas (*Proc. Zool. Soc.*, 1912, p. 128) as an unidentified *Simia* of the *rhesus*-group.

There is no doubt whatever that this female is *lasiotus* and it possesses a well developed tail. It was shot on February 6th, 1911, when in fuller winter coat. But the coat is not particularly long or thick and is not at all shaggy or woolly. It is about the same in length and consistency as in DeGacour's Tonkin specimens shot in December, but the tail is exceptionally well haired, the hairs increasing in length from the base to the tip. The general colour is decidedly dark, the under hair of the upper side and outside of the limbs being everywhere deep slate grey, especially dark and sooty on the back. The hairs of the head and shoulders are annulated with rusty yellow which increases in amount and intensity posteriorly and becomes bright rusty on the thighs. The arms and hands are very deep brownish olive grey, and faintly annulated; the legs like the thighs but paler and the feet are paler still and greyer. The under side is a dirty grey. The cheeks are rather dark and there is a good deal of black hair round the face.

The male, which died in May, is also in good coat and very like the female in colour, although a little darker and rustier brown on the thighs and with a decided wash of reddish on the belly.

The measurements of the skin of the young-adult female taken in the flesh by Malcolm P. Anderson, indicate a Macaque by no means unusual in size, the head and body being 490 mm. (= 19 3/5 ins.) and the tail 260 mm. (= 10 2/5 ins.). But the tail is unusually

¹ In another example assigned to this race and shipped from Shanghai to the Zoological Society, where it arrived in Jan. 1880 and died in June 1881, the tail is represented by a stump about half an inch long. The June coat is longer, coarser, more distinctly annulated and paler grey at the base, the rump redder in the two known definitely to have come from Sze-chuen. This skin would pass anywhere for typical Indian *M. m. mulatta*.

THE RHESUS MACAQUES (*MACACA MULATTA*) 549

long, exceeding half the length of the head and body. It does not approach that on the dried skin, falling short of half the head and body even with its long terminal hairs included.

The skull of the ♂, figured and described by Anderson is heavy, massive and exceptionally broad across the orbits and zygomata, the latter and the lower part of the orbital rim being also exceptionally stout. Although the sutures are everywhere faint, the teeth are hardly worn; but the canines have been cut off short as is a common custom with male monkeys in captivity. Apart from its greater massiveness and breadth, to which Anderson attached considerable importance in separating *lasiotus* specifically from *mulatta* (*rhesus*), the skull differs from those of adult and old males of *mulatta* in the great distance between the temporal ridges on the parietal bones where they are more widely separated than on the frontals. In skulls of typical *mulatta* of about the same age these crests lie near together over the parietals where they are closer together than on the frontals. But I mistrust all these features because the monkey had been in captivity an unknown length of time, probably many years, since it is improbable that it was captured as an adult animal. Captivity alters monkey skulls in a variety of curious ways, excessive weight of bone often being one of them; and if during its cage-life this macaque used its jaws less than a wild monkey by being fed, maybe, on softer food, we get the explanation of the widely separated temporal crests.

The skull of the female has the sutures very clearly defined, no trace of the temporal crests and perfect unworn teeth. It is probably neither quite full sized nor fully developed since it has a shallower upper jaw and less pronounced, more sloping brow-bridge than in full grown examples of typical *mulatta*. It exhibits a peculiarity in the comparative flatness of the parietal region of the skull imparting an unusual prominence to the occiput. This I regard as an individual peculiarity since a very similar variation occurs in a female skull of typical *mulatta* from the Mishmi Hills, Assam, and is exhibited more or less in others.

Racially this Chinese Macaque may be distinguished from the Indian by its darker colour, probably larger size and bushier, perhaps longer tail.

Skull measurements of *M. m. sancti-johannis* and of
M. m. lasiotus.

Locality and Sex	Skull in inches.				Teeth in mm.		Remarks
	Total Length	Zygom. Width	Orbital Width	Width of Maxilla	Upper Cheek Teeth	1st Upper Molar	
Fokien, ♂	4.7	3.3	2.7	1.5+	32	8 × 8	Type of <i>littoralis</i> .
" ♀	4.6	3	2.5	1.6	34	8 × 8+	
Szechuen, ♂	5.3	3.9	3.3	1.7+	34	9 × 8	Type of <i>lasiotus</i> .
" ♀	4.7	3.1	2.6	1.6	34	8 × 8	

THE RHESUS OF NORTH CHINA.

Macaca mulatta tcheliensis, M.-Edwards.*Macacus tcheliensis*, A. Milne-Edwards, *Rech. Mamm.* p. 227, pls. xxxii and xxxiii, 1870.*Locality:* The mountains to the east of the Province of Tche-li, N. China.

Milne-Edwards himself when describing this Macaque suggested the possibility of its belonging to the same species as *lasiotus* from Szechuen. This suggestion was adopted as a certainty by Anderson in 1878 and since then its name has figured, but quite wrongly, in the synonymy of the Szechuen form.

There seems to be nothing to justify that view in the original description of *tcheliensis*, which is evidently a much paler animal than *lasiotus*; but the artificial basal truncation of the tail in the type and only known specimen of *lasiotus* obscured the principal difference between the two.

M. m. lasiotus, as recorded above, has the tail at least as long as in typical *mulatta*, whereas M.-Edward's recorded measurements of the type of *tcheliensis* and his illustration of the animal show that the tail is only about one third the length of the head and body and a fraction longer than the hind foot. In this respect the Tcheli Rhesus very closely resembles the Hong Kong or Fokien Rhesus (*M. mulatta sancti-johannis*).

Milne-Edwards described his specimen, a female apparently in short summer coat, as being bright reddish fulvous in general hue, with the tail bright yellowish tawny and the hands greyish yellow. The only example I have seen is the skin of an adult male, ticketed 'N. China', presented by the Zoological Society, where it was received in August 1880 and died on March 6th 1881, in the perfect winter coat, long, thick and beautifully soft. On the shoulders the hairs are about 3 inches but towards the axilla they are over 4 inches long and on the head about $1\frac{1}{2}$ inches. The general colour above is brown, ochreous on the head and fore quarters, much brighter and redder on the rump and thighs; but on the fore quarters there is only a faint trace of annulation in the hairs. Beneath their reddish tips the hairs are pallid grey, turning nearly white quite at the root. The cheeks are dusker than the top of the head, the arms are olive grey, unspeckled, the legs and feet washed with dull yellow, the tail is nearly the same tint as the loins but darkening distally and the under side is greyish white except the scrotum which is clothed with reddish hair. On the made-up skin the tail without the hair is 5.2 inches, with the hair 7.6; the feet, not shrunk, are 5.3 inches and the head and body from the crown to the root of the tail $1\frac{1}{2}$ ft.

This male is not so pale apparently as the type described and figured by Milne-Edwards.

THE RHESUS MACAQUES (MACACA MULATTA) 551

As compared with the skins of *lasiotus* it may be noted that, apart from the shortness of the tail, this skin from N. China differs in colour and coat, its tint being not so dark, the under fur especially much paler and the coat far longer and more luxuriant than that of the Szechuen female shot in February and also in full winter pelage.

THE SNAKES OF IRAQ.

BY

NORMAN L. CORKILL, M.B., CH.B., F.Z.S.

Late Iraq Health Service.

In 1927, when the writer was appointed to teach Biology in the new medical college at Baghdad, little appeared to be definitely known about the snakes of the country. There were people who said that no poisonous snakes were to be encountered in Iraq, and others who vouched vehemently to have seen Kraits and Russell's vipers.

The Central Laboratory had, however, identified specimens of *Echis carinatus* and *Vipera lebetina* in connection with snake-bite fatalities and there was in existence a scanty literature.

The literature comprised *Notes on the Animals of Mesopotamia*,¹ a small booklet published by the B.N.H.S. in 1916, a paper in the Journal of the Society by Boulenger in 1920², and a further paper by Miss Joan Procter³ in the same publication the following year. The information about Mesopotamian snakes in the first of the above is apparently a collection of the relevant data from Boulenger's Catalogue of Snakes in the British Museum.⁴ Boulenger's 1920 paper is a list of specimens taken by members of the Mesopotamian Expeditionary Force during the War, and Miss Procter's contribution is a similar and additional list.

Cases of snake-bite, some fatal, kept cropping up, and in most instances the snake was not secured. It was thought worth while to attempt something in the nature of a rough survey of the country's snake population with a view to establishing the species that occurred, ascertaining if there were any peculiarities of distribution or relative abundance, and formulating some simple key or means by which the poisonous species could be identified easily in the field. Moreover it was thought advisable to have a representative collection of specimens in Baghdad.

Officials were written to in the provinces and responded generously with specimens and notes. Searches were made in hospitals and laboratories, and specimens were unearthed from mouldy oblivion on several occasions. The Royal Air Force Medical Service and the British Officers of the Assyrian Levies contributed valuable material and notes, and students provided a further fruitful source. The investigation covered roughly two years, 1928 and 1929, the significance of the data amassed being assessed in mid-1930.

The writer has no claim to any specialist knowledge of snakes and is painfully aware that much information that might have been collected from the hundred odd specimens examined, was lost through lack partly of time, partly of works of reference, but mainly through

¹ Bombay Nat. Hist. Soc. : Notes on the Animals of Mesopotamia, 1916.

² Boulenger, G. A. : A List of Snakes from Mesopotamia. *J. B. N. H. Soc.* xxvii, No. 2, 1920.

³ Joan. Procter : Further Lizards and Snakes from Persia and Mesopotamia. *J. B. N. H. Soc.* xxviii, No. 1, 1921.

⁴ Boulenger, G. A. : Catalogue of Snakes in the British Museum, 1893-96.

lack of knowledge. Much has been learnt since farewell was said to the specimens, now in the Zoology Museum of the Royal College of Medicine, Baghdad. However, it has been thought as well to put on record the few additions to our knowledge of Mesopotamian snakes that accrued.

I am indebted, for permission to publish, to the Director of Public Health, Iraq, the Inspector-General of Health Services, Iraq, and the Dean, the Royal College of Medicine, Baghdad.

Modern political Iraq is a land of diverse features. To the north-east, the desert plains of the south and west break up to be replaced by the hills and mountains rising away to Persia. To the south stretches the monotonous plain threaded by the two rivers, away to the Persian Gulf. The course of the River Euphrates is beset with lake and marsh. The great Shamiyah Desert rolls away in a gradual ascent to the west. Extremes characterise the climate; a temperature of 125° F. is a commonplace in the summer in Baghdad, and I have seen frozen puddles on the roads during winter. In Kurdistan, the north and north-eastern portion of Iraq, it is of course much colder in winter.

As might be expected, having regard to the geographical position and physical make-up of the country, its fauna is a jumble. Species that are typically European, African and Asiatic, all occur, and in the waters of the Persian Gulf is found a sea snake (*E. schistosa*) which ranges as far as China and Australia.

It is considered that the twenty-four specimens dealt with below are unlikely to be supplemented in the future. They represent over two years collecting from all parts of the country and the available literature has been utilised. Seven families are represented and fifteen genera. These are Typhlops, Leptotyphlops, Eryx, Natrix, Coluber, Lytorhynchus, Contia, Tarbophis, Malpolon, Psammophis, Enhydrina, Naja, Vipera, Cerastes, and Echis. Of the *Colubridæ* there are eleven *Aglyphs* and four *Opisthoglyphs*. The old *Proteroglyphs* are represented by one of the *Hydrophiidæ* and one of the *Elapidæ*. The vipers number three. Five of the twenty-four species are considered to have venoms dangerously toxic to man. These species are *Enhydrina schistosa*, *Naja morgani*, *Vipera lebetina*, *Cerastes cornutus*, and *Echis carinatus*.

Family : TYPHLOPIDÆ.

Typhlops braminus, Daudin.—The Common Worm Snake.

Vernacular Names.—It would most likely be spoken of as 'Dood' which is the Arabic for worm.

This species has been recorded from South Africa, Arabia, Southern Asia as far over as the Philippines Island in the Indian Ocean and Mexico. One suspects the last named to be an importation. During the Great War a single specimen was taken in Basra.¹

The distribution being what it is, there is no reason why *T. braminus* should not be fairly common in Iraq. Its nocturnal and burrowing habits will, of course, provide against its being frequently encountered.

¹ Boulenger, G. A. : A List of Snakes from Mesopotamia. *J. B. N. H. Soc.* xxvii, No. 2, 1920.

Typhlops vermicularis, Merrem.—The Greek Blind Snake.

Synonyms.—*Typhlops syriacus*,¹ *Typhlops wilsoni*.²

Vernacular Names.—Like the preceding species this snake would be spoken of by the Iraqi Arab as a 'Dood', that is, worm.

Specimens have been recorded from Greece and its Archipelago through the Levant to Persia, Afghanistan and Turkestan.

Iraq may now take its place in this list as two specimens were obtained in 1928 and 1929.

Locality.	Length (ins.)	Rows.	Nasals.	Length : Breadth.	Remarks.
Baghdad ...	9.2	24	Division incomplete.	46 : 1	Purplish brown, belly paler.
Nasiriyah ...	6.5	24	„	50 : 1	„

Like *T. braminus*, this species is probably fairly common in the country.

Family : LEPTOTYPHLOPIDÆ.

Leptotyphlops macrorhynchus, Jan.

Synonyms.—*Glaucania macrorhynchus*.³

Vernacular Names.—This snake, again, would probably be referred to as 'Dood', but it would be called a 'Sul' by some natives who say that the attributes of the latter are thinness, redness, smallness and the ability to jerk about with great activity.

Previous records for the species include North Africa, Sind, Baluchistan and, in Iraq, 'Euphrates' and 'Faleya' (Fallujah?).⁴ During 1928-29 three further specimens were taken in the country. Two were revealed during digging operations on the south bank of the Diyala River at Baqubah and the other specimen was secured in Nasiriyah. The species would appear to be uniformly distributed throughout riverain Iraq.

Locality.	Size (ins.)	Rows.	Tail—Total Ratio.	Remarks.
Baqubah ...	7.3	14	1/10	Uniform pink.
Do. ...	8.0	14	1/11	„
Nasiriyah ...	8.8	14	1/12	Uniform brown.

Family : BOIDÆ.

Sub-family : BOINÆ.

Eryx jaculus familiaris Linnæus.—The Javelin Sand Boa.

Vernacular Names.—'Batra' is applied to the Sand Boa throughout Arabic-speaking Iraq.

¹ Jan.: Icon. Oph., p. 15, l. 3, 1864.

² Wall. F.: J. B. N. H. Soc. xviii, p. 802, 1908.

³ Boulenger, G. A.: Catalogue of Snakes in the British Museum, 1893-96.

⁴ Boulenger, G. A.: A List of Snakes from Mesopotamia. J. B. N. H. Soc. xxvii, No. 2, 1920.

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The species ranges from Algeria, Egypt, the Levant, Roumania, Greece and Turkey through Asia Minor and Iraq to Persia. In Iraq, specimens have been previously recorded from Basra, Sheikh Saad, Shaiba, Amara, Baghdad and 'Mesopotamia'.¹ In 1928-29 eight more specimens were examined. They came from Baghdad¹, Baqubah¹, Hinaidi and Nasiriyah in the riverain plains, Mandali at the foot of the Pusht-i-Kuh and Sulamainia in the Kurdish hills. The species is apparently uniformly distributed throughout the country.

Locality	Size (ins.)	Ventrals	Caudals	Dorsal Rows	Colour (dorsum)	Tail-Total Ratio	Remarks
Baghdad	26	200	26	51	Greenish yellow with brown markings	1/13	
"	10.5	200	30	50	"	1/10	
Hinaidi	19.5	195	28	49	"	1/13	
Baqubah	25	197	21	47	"	1/15	Tail mutilated.
"	32	202	25	51	"	1/11	
Nasiriyah	18.5	186	30	53	"	1/11	
Mandali	18	203	31	53	"	1/10	Markings very heavy. Belly speckled.
Sulamainia	10	205	31	51	Pale grey with brown markings	1/10	

In all specimens the perioculars numbered eleven and the anal scale was undivided. The dorsal scales were invariably keeled posteriorly. The bellies were of a uniform white or pale straw colour with the exception of the Sulamainia specimen which had a heavy speckling of dark brown. The scale counts of ventrals, caudals and dorsal rows average higher than the Egyptian specimens reported by Anderson.

Family : COLUBRIDÆ.

Series : AGLYPHA.

Natrix tessellatus Laurenti.—The Tessellated Water Snake.

Synonyms.—*Tropidonotus tessellatus*.²

Vernacular Names.—Known to the Arabs of riverain Iraq as 'Haia al Mai'.

The distribution of the species is South Europe and Russia, Egypt and the Levant, Asia Minor, Iraq, Persia, Siberia, West China and

¹ Boulenger, G. A. : A List of Snakes from Mesopotamia. *J. B. N. H. Soc.* xxvii, No. 2, 1920.

² Boulenger, G. A. : Catalogue of Snakes in the British Museum, 1893-96.

North-West India. In Iraq specimens have hitherto been recorded from Basra and Fao,¹ and also from Basra, Qualet Saleh, Sheikh Saad, Haqicole, Faleya (Fallujah?), and Zobeya (Zobeir?).² Fifteen new records were obtained in 1928-29. All had the dorsals strongly keeled in nineteen rows, the anal was invariably divided and the supralabials always numbered eight. In all but three specimens the fourth supralabial only, entered the orbit. Colour varieties were numerous and were not related to size or 'counts' nor was any one colour variety apparently peculiar to any particular locality or type of habitat.

Locality	Size (ins.)	Ventrals	Caudals	Colour	Remarks
Baghdad ...	22	169	58	Jet black. Belly spotted white.	Fourth and fifth supralabials enter eye.
" ...	29	167	56	Olive. Belly black and white.	...
" ...	25	166	57	"	...
" ...	24	173	60	"	...
Nasiriyah ...	23.5	169	62	"	...
" ...	25.5	171	65	"	...
Nejaf ...	25	168	61	"	...
Tuz ...	19	168	66	"	...
" ...	19	170	64	Olive with brown markings. Belly black and white.	Fourth and fifth supralabials enter eye.
Baqubah ...	27	170	61	"	...
" ...	34	167	55	"	...
Mosul ...	21	171	66	Olive with brown markings. Belly white.	...
Beled Ruz ...	29	167	73	Olive with brown markings. Belly black and white check.	Third, ... fourth and fifth supralabials enter eye.
Hinaidi ...	26	172	63	"	...
Mandali ...	24	169	62	"	...

This is one of the two commonest snakes in the country and may be seen in numbers almost anywhere in Iraq particularly after the annual floods. I have seen many in pools in the Euphrates near Nasiriyah swimming about vigorously and often with small fish in their mouths. They always assume a very aggressive attitude when approached.

Coluber dahlia Fitzinger.—The Dahl's Whip Snake.

Synonyms.—*Zamenis dahlia*.

Vernacular Names.—Shares the Arabic name 'Zerrag' with *C. ventrimaculatus*.

This species is found in South Europe, Egypt, the Levant, Asia Minor, Iraq and Persia. In Iraq specimens have been recorded

¹ Bombay Nat. Hist. Soc.: Notes on the Animals of Mesopotamia, 1916.

² Boulenger, G. A.: A List of Snakes from Mesopotamia. *J. B. N. H. Soc.* xxvii, No. 2, 1920.

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previously from Baghdad.¹ In 1928 a further specimen was secured from a Baghdad garden and in 1929 another was sent in from a garden in Baqubah.

Locality	Size (ins.)	Ventrals	Caudals	Remarks
Baghdad ...	45	2.5	132	Both specimens were olive with white bellies. Anteriorly there were 5 pairs of yellow-edged dark green blotches; the anterior pair had united to form a collar.
Baqubah ...	39	215	133	

In each case the tail was about a third of the body length, there were nineteen rows of scales, the anals were divided and there were eight supralabials, the fourth and fifth of which entered the eye. This snake seems to be quite rare in Iraq.

Coluber diadema Schlegel.—The Clifford's Whip Snake.

Synonyms.—*Zamenis diadema*.²

Vernacular Names.—Known to the Arabs of the plains as 'Raqta'.

Clifford's Whip Snake is found in North Africa, Arabia, Iraq, Persia, Turkestan, Baluchistan and Kashmir.

In Iraq specimens have been previously recorded from Basra, Baghdad, Sheikh Saad, Shaiba, Faleya (Fallujah?), Zobeya (Zobeir?), Nasiriyah, Baqubah, and Daur.¹ Twelve new specimens were secured in 1928 and 1929.

Locality	Size (ins.)	Ventrals	Caudals	Rows	Perioculars	Supralabials	Remarks
Baghdad ..	30	220	72	29	9	11	Olive, darker markings.
" ...	21	218	74	33	9	11	" "
" ...	53	226	68	31	7	12	" "
" ...	49	222	72	31	8	11	" "
Fallujah ...	55	207	60	29	8	11	" "
Nasiriyah ...	52	214	70	31	8	11	" "
" ...	50	218	74	31	8	11	" "
Samarra ...	36	216	73	31	8	11	Brown, darker markings.
Baqubah ...	46	223	65	31	8	11	Olive, darker markings.
Gebal Hamrin	42	229	68	31	9	11	" "
Khanlqin ...	41	224	65	33	9	11	" "
Sulamainia ...	33	233	87	35	9	13	Pale grey, darker markings.

¹ Boulenger, G. A. : A List of Snakes from Mesopotamia. *J. B. N. H. Soc.* xxvii, No. 2, 1920.

² Boulenger, G. A. : Catalogue of Snakes in the British Museum, 1893-96.

In all of the specimens the anal was divided, the dorsals were keeled, particularly posteriorly; the belly was of a pale uniform straw colour, and the darker markings were heavy and defined. The three longitudinal marks on the head and neck were invariably distinct. The tail averaged a sixth of the total length.

Specimens were taken in such diverse habitats as houses, riverain cultivation, desert and mountain. A small rat was removed from the stomach of a Baghdad specimen.

Coluber jugularis Laurenti.—The European Whip Snake.

Synonyms.—*Zamenis gemonensis*.¹

Vernacular Names.—Known to the Arabs of Iraq as 'Arbid' or 'Abrid' i.e. the black snake. It presumably shares the name with the much rarer and smaller *Naja morgani*.

It has been recorded from the West Coast of Europe to South Western Asia. The '*asianus*' variety to which most Iraqi specimens seem to belong is found in Egypt, the Levant, Iraq and Persia. In Iraq specimens have previously been taken in Baghdad, Basra, Amarah, Haqicole and Faleya (Fallujah?).² In 1928-29 further specimens were secured from Baghdad, Baqubah and Nasiriyah, the North of Iraq not being at all represented.

The eight specimens recorded below had their dorsals in nineteen rows, the anal divided and eight supralabials with the fourth and fifth invariably entering the orbit. The tail was a third to a quarter of the total length. The colour of the dorsum ranged from dark brown to black, each individual scale having a pale yellow or white longitudinal streak. The bellies were either red, yellow, or white, blotched and peppered with black, or of a uniform white.

Locality	Size. (ins.)	Ventrals	Caudals	Remarks
Baghdad	52	165	104	
"	43	198	124	
"	46	203	92+	Tail mutilated.
"	52	198	100	
Baqubah	48	202	98	
"	53	188	107	
Nasiriyah	45	193	100	
"	50	198	99	

The 'Urbid' is much feared by the Arabs, possibly on account of its large size and fierceness when cornered, but also I am inclined to think, because it is unlikely to be distinguished from the uniformly black *Naja morgani*. Certainly the latter is not a 'biter' as far as

¹ Boulenger, G. A. : Catalogue of Snakes in the British Museum, 1893-96.

² Boulenger, G. A. : A List of Snakes from Mesopotamia. *J. B. N. H. Soc.* xxvii, No. 2, 1920.

records go but it belongs to a poisonous genus, accidents with it have probably occurred and any 'Urbid' or black snake thereafter would be feared.

Coluber ravergeri Menétriés.—Ravergier's Whip Snake.

Synonyms.—*Zamenis ravergeri*.

Vernacular Names.—Too rare in Iraq to have one. Would probably be spoken of as a 'Zerrag'.

The distribution is Transcaucasia, Persia, Baluchistan and Afghanistan. There are no previous records from Iraq. Two specimens were obtained in the Autumn of 1929, one from a Mosul house and the second from an earthwork near the town. In each there were two pre-oculars and two post-oculars, the anals were divided, the dorsal rows were faintly keeled and numbered twenty-three, and in each case the fifth and sixth labials entered the orbit. The tails were a quarter of the respective body lengths.

In both specimens the three characteristic longitudinal dark lines on the tail were beautifully defined.

Locality	Size (ins.)	Ventrals	Caudals	Supra-labials.	Colour	Remarks
Mosul, House	42	210	98	9	Pink with brown markings.	Markings very defined.
Mosul, Earth-works.	40	210	102	10	Olive with brown markings.	Less so.

The snake is a rarity and Iraq appears to be the westernmost limit of *Var. typica*, further West a *Var. nummifer* is found.

Coluber ventrimaculatus Gray.—Gray's Whip Snakes.

Synonyms.—*Zamenis ventrimaculatus*.¹

Vernacular Names.—Known throughout Arabic-speaking Iraq as 'Zerrag' and 'Nishab', both words meaning 'arrow' and being applicable apparently to any thin and swift snake. The names would thus be used also of *C. dahlia* and *C. ravergeri*. I have a note to the effect that in Diwaniyah a specimen taken from a date palm was referred to as 'Jaferiyah'. It is also quite commonly referred to as 'Haiat al Asfar', the yellow snake.

The Bombay Natural History Society² gives the distribution as Mesopotamia to India. Wall³ limits the Indian distribution to the North-West of the Peninsula. Tristram records it from Palestine.⁴

In Iraq previous records are from 'Euphrates (Euphrates Expedition)', 'Mesopotamia' and Fao,² also from Basra, Sheikh Saad, Ezra's Tomb (Qurna), Shaiba, Faleya (Fallujah?), Zobeya (Zqbier?),

¹ Boulenger, G. A. : Catalogue of Snakes in the British Museum, 1893-96.

² Bombay Nat. Hist. Soc. : Notes on the Animals of Mesopotamia, 1916..

³ Wall, F. : How to Identify the Snakes of India, 1923.

⁴ Tristram, H. B. : Survey of Western Palestine, 1883.

Nasiriyah, Baqubah and Daur.¹ Others again from Baghdad and Amarah.² In 1928-29 eighteen further specimens were examined out of literal dozens sent in. The localities represented were Baghdad, Basra, Nasiriyah, Nejaf, Diwaniyah, Baqubah Hillah and Tuz Khurmatu.

Locality	Size (ins.)	Ventrals	Caudals	Supra-labials	Touching eye	Remarks
Baghdad ...	32	210	100	9	5-6	
" ...	14	200	76	10	4-5	
" ...	41	210	75	10	6-7	
" ...	14.5	205	93	9	5-6	
" ...	40	210	99	9	5-6	
" ...	40	210	93	9	5-6	
Nasiriyah ...	43	211	90	9	5-6	
" ...	23	209	87	9	5-6	
Basra ...	33.5	204	85	9	5-6	
Nejaf ...	36	220	94	9	5-6	
Diwaniyah ...	40	215	99	9	5-6	Taken in a date palm.
Baqubah ...	39	217	86	9	5-6	
" ...	41.5	208	82	9	5-6	
" ...	34	211	100	9	5-6	
Hillah ...	29.5	211	79	9	5-6	
" ...	35	218	85	9	5-6	
Tuz ...	37	209	93	9	5-6	
Iraq ...	28	211	97	9	5-6	

In all specimens the tail approximated to a quarter of the body length, the dorsal rows numbered nineteen, the anal was divided, and the colours were, dorsally, olive barred crosswise with black, and ventrally a pale straw ground with lateral black spots in a regular series. The nape was invariably heavily marked with a thick black longitudinal line and the vertex of the head usually bore two black markings like 'commas' placed back to back.

¹ Boulenger, G. A.: A List of Snakes from Mesopotamia. *J. B. N. H. Soc.* xxvii, No. 2, 1920.

² Procter, Joan.: Further Lizards and Snakes from Persia and Mesopotamia. *J. B. N. H. Soc.* xxviii, No. 1, 1921.

This snake is extremely common in houses and gardens in Iraq. It feeds on small frogs and lizards. When handled it bites fiercely but of course quite harmlessly. Two natives that were produced on different occasions for me to see because they claimed to be snake-charmers, brought the Gray's Whip Snake with them as their stock-in-trade. It is probably this snake of which the Sumerians have left a record in their word 'Dashna', a yellow or green snake.

Lytorhynchus diadema Dum. and Bibr.—The Diademed Sand Snake.

Vernacular Names.—Being rare, insignificant and possessed of no notable attribute it has no vernacular name as far as I know.

Its distribution is North Africa, Arabia, Syria, Iraq and Persia. In Iraq specimens have previously been recorded from Shaiba and Faleya (Fallujah?).¹ At the end of 1929 a further specimen was secured from Rutba in the Shamiyah Desert. The specimen was eleven inches long, the tail being a seventh of the total length. The ventrals numbered 171, the caudals 36, and the dorsal rows 19. The anal was divided. There were eight supralabials of which the fifth entered the eye. There were two pre-oculars. The pupil was circular although, according to the literature, it should be vertically elliptic. The 'bobbin' shaped rostral was beautifully exhibited. The dorsum was coral-red with thirty heavy black cross bars. The belly was white. A black cephalic blotch was continued through the eyes from the vertex to the corners of the mouth.

Contia collaris Menétriés.—The Collared Dwarf Snake.

Vernacular Names.—None are known of.

The distribution is Caucasus, Syria, Iraq, Persia and Arabia. In Iraq, specimens had previously been recorded from 'Ruins of Nineveh'² and Baghdad.¹ In 1929 two further specimens were obtained. One was taken from the crop of a houbara (*Chlamydotis undulata*), shot in the neighbourhood of Baqubah, and the other was sent from Sulamainia in the Kurdish hills.

Locality	Size (ins.)	Ventrals	Caudals
Baghdad	12	172	62
Sulamainia	10	195	62

In both specimens the tail was a quarter of the body length, the rows numbered fifteen, the anal was divided, and the supralabials numbered seven of which the third and fourth entered the eye. The colour was fawn with the head and neck heavily blotched with black; the belly was a pearly white.

Contia coronella Schlegel.—The Syrian Dwarf Snake.

Vernacular Names.—None known of.

¹ Boulenger, G. A. : A List of Snakes from Mesopotamia. *J. B. N. H. Soc.* xxvii, No. 2, 1920.

² Boulenger, G. A. : Catalogue of Snakes in the British Museum, 1893-96.

The distribution is Syria, Palestine, Iraq and Persia. In Iraq, specimens have previously been recorded from Shaiba, Zobeya (Zobeir?) and Faleya (Fallujah?).¹ In 1928 a specimen preserved in spirit was unearthed from a Baghdad office. It was labelled 'Rutba'.

It was 7.4 inches long, the tail measuring two inches. The ventrals numbered 136, the caudals 45, and the dorsal rows 15. The anal was divided and there were seven supralabials of which the third and fourth entered the eye. There were two post-oculars. The dorsum was a dull brown (spirit specimen) with sixty-three darker regular cross bars, the first one being markedly heavy and forming a collar. The belly was white with a faint suggestion of speckling.

Contia decemlineata Dum. and Bibr.—*The Lined Dwarf Snake*.

Vernacular Names.—None known of.

The distribution is Syria, Palestine, Iraq and Persia. There are no previous records from Iraq, but in 1929 three specimens were received from the Kurdish hills. One specimen had the head and neck destroyed and one had the extremity of the tail missing.

Locality	Size (ins.)	Ventrals	Caudals	Remarks
Sulamainia (alt. 1,300 ft.)	21	171	66	Complete specimen.
Tislaja (alt. 2,500 ft.) ...	21+	145+	66	Head and neck destroyed.
Diana (alt. 1,600 ft.) ...	13+	163	30+	Tail mutilated.

The tail of the intact specimen was a quarter of the total length, the dorsal rows numbered seventeen and the anal was divided in all three specimens. The two complete heads exhibited seven supralabials with the third and fourth entering the eye, one pre-ocular, and two post-oculars. All three were alike in colouring. The dorsum was a pale fawn with two pairs of longitudinal fine brown lines; a pair running down each side of the back. The individual dorsal scales had barely perceptible, central, paler streaks. The bellies were pearly white.

All three specimens were taken in September in gravelly areas at considerable altitudes.

Contia persica (Anders.)—*The Persian Dwarf Snake*.

Vernacular Names.—None known of.

The distribution is Iraq and Persia. From Iraq two specimens are recorded², one from Kizil Robat and the other from the neighbouring Jebal Hamrin hills.

I am not at all satisfied as to the relationship of *C. collaris* and *C. persica* and would like to examine a larger series of the genus

¹ Boulenger, G. A. : A List of Snakes from Mesopotamia. *J. B. N. H. Soc.* xxvii, No. 2, 1920.

² Procter Joan. : Further Lizards and Snakes from Persia and Mesopotamia. *J. B. N. H. Soc.* xxviii, No. 1, 1921.

in Iraq. One or two valuable characteristics I unfortunately made no note of at the time when examining the two specimens recorded under *C. collaris*; in colour they were identical.

Series: OPISTHOGLYPHA.

Tarbophis fallax iberus Eichwald.—The Caucasian Cat-Snake.

Synonyms.—*Tarbophis iberus*.¹

Vernacular Names.—None known of.

The distribution is Caucasus, Iraq and South-West Persia. Six specimens have previously been recorded from Baghdad and Mesopotamia.² In 1928 and 1929 a further eight were examined from Baghdad, Mandali and Khaniqin.

Locality	Size (ins.)	Ventrals	Caudals	Dorsal colour markings	Remarks
Baghdad	44	240	68	46 spots	Light specimen. Third, fourth and fifth supralabials enter eye.
"	32	217	73	60 "	Divided anal. Light specimen.
"	17	224	91	50 "	Dark specimen. Seven supralabials. Belly dark.
"	16	239	67	(?)	Faded old spirit specimen.
"	14	237	80	48 "	Belly very dark. Third, fourth and fifth supralabials enter eye.
"	13	232	72	45 "	Very dark specimen. Third and fourth supralabials enter eye.
Mandali	21	216	63	47 "	Light specimen.
Khaniqin	30	239	31	(?)	"

The tails averaged a sixth of the total lengths. The rows of dorsals numbered 21 invariably and, with the exception of one specimen (Baghdad No. 2), the anals were all undivided. The supralabials numbered 8 in all specimens but one (Baghdad No. 3) and in five specimens (Nos. 2, 3, 4, 7 and 8) the fourth and fifth entered the eye. The iris was invariably golden. The colour of an adult specimen was pale brownish pink with barely perceptible brown blotches 46 to 60 in number. The bellies were white, blotched, peppered, and marbled, irregularly with black. In the specimens under 20 inches in length, the dorsum was darker and more grey than

¹ Boulenger, G. A.: Catalogue of Snakes in the British Museum, 1893-96.

² Boulenger, G. A.: A List of Snakes from Mesopotamia. *J. B. N. H. Soc.* xxvii, No. 2, 1920.

pink, and the black element very much predominated on the venter, in some cases the venters being practically entirely black. One's first impression on examining the series was that two species were involved but as the proportions and counts agreed, and as all four of one colour type were small, and the other four specimens were all large, and of the other colour type, one is led to suggest that the snake grows lighter as it grows more mature.

All specimens were taken in gardens or cultivation except one small one which was found amongst the 'drinks' in a pantry. Five were handled alive and were of a very tranquil disposition. The Khaniqin specimen was killed with a sparrow firmly embedded in its jaws.

Malpolon monspessulana Hermann.—The Montpellier Snake.

Synonyms.—*Calopeltis monspessulana*.¹

Vernacular Names.—None known of definitely. Possibly it is the snake spoken of as 'Hannash.'

The distribution is from North Africa, the Mediterranean and the Adriatic to the Levant, Iraq, Caucasus and Persia. Previously one had been recorded from Baghdad.² In 1928-29 nine more specimens were examined all from Northern Iraq, being from Baghdad, Mosul, Tuz Khurmatu, and Suwara Tuka, North of Mosul.

Locality	Size (ins.)	Ventrals	Caudals	Colour	Remarks
Baghdad ...	26	163	55+	Bluish grey with pale-edged darker spots. Belly white.	Tail mutilated. Dorsal rows 19.
" ...	40	200	104	"	"
" ..	31	176	40+	Olive brown, belly straw.	Tail mutilated.
" ...	36	186	100	"	...
" ...	34	176	84	"	...
" ...	30	174	42+	"	Tail mutilated.
Tuz ...	36	172	90	"	...
Mosul ...	33	172	29+	"	Tail mutilated.
Suwara Tuka (alt. 2,000 ft.)	10 5	170	66	Chocolate brown, belly white.	...

In the complete specimens the tail was a quarter of the body length. In all specimens there were eight supralabials of which the fourth and fifth entered the eye. The anal was invariably divided.

¹ Boulenger, G. A. : Catalogue of Snakes in the British Museum, 1893-96.

² Boulenger, G. A. : A List of Snakes from Mesopotamia, *J. B. N. H. Soc.* xxvii, No. 2, 1920.

The dorsals were always deeply grooved. Numbers 1 and 2 in the list would appear to be var. *insignitus*¹ and the others var. *neumayeri*.¹ It is remarkable that no fewer than four of the nine had mutilated, that is abbreviated, tails. Most of the specimens came from gardens or cultivation. Four of the six Baghdad specimens came from the highly cultivated Rustum Farm, south of Baghdad, a place with a considerable rodent population.

Malpolon moilensis Reuss.—The Moila Snake.

Synonyms.—*Cælopettis moilensis*.²

Vernacular Names.—None known of.

The distribution is North Africa, Syria, Arabia, Iraq and Persia. In Iraq, specimens have been recorded from Sodom, Sheikh Saad and Shaiba.³ No fresh specimens were seen in 1928 or 1929.

Psammophis schokari Forskal.—The Variable Sand Snake.

Vernacular Names.—None known of.

The distribution is from North Africa to Arabia, Syria, Palestine, Iraq, Persia, Baluchistan, Afghanistan and Sind. In Iraq, specimens had previously been recorded from Basra and Shaiba.³ In 1929 a further specimen was brought in from Rutba in the Shamiyah Desert.

The specimen was a young snake, twelve inches long with an olive dorsum streaked with two dark longitudinal bands. The belly was edged longitudinally with the characteristic interrupted lines. The ventrals numbered 183, the caudals 96 and the dorsal rows 19. The anal was divided, and of the nine supralabials, the fifth and sixth entered the eye.

Apparently quite a rarity in Iraq.

Family: HYDROPHIIDÆ

Enhydrina schistosa Daudin.⁴—The Hook-nosed Sea Snake.

Synonyms.—*Enhydrina valakadyen*.⁵

Vernacular Names.—None known of.

The distribution is given by Malcolm Smith as from the Persian Gulf to the coast of Cochin-China and the North Coast of Australia. None have been reported from the waters of the Persian Gulf that wash the coastal extremity of Southern Mesopotamia, but in 1929 four snakes were discovered in spirit in the Laboratory at Rustum Farm, Agricultural College, Baghdad. They were labelled '*Hydrophis cyanocincta*—Persian Gulf' and were assumed to be duplicates of the 1921 Cox Cheeseman collection.

No helpful literature was available in Iraq at the time and in consequence very few particulars relating to the specimens were looked for and recorded. However the rows numbered 54 at mid-body, the rostral projected over the lower jaw, the ventrals were barely differentiated, and the individual scales were not imbricate; they

¹ Boulenger, G. A. : The Snakes of Europe, 1913.

² Boulenger, G. A. : Catalogue of Snakes in the British Museum, 1893-96.

³ Boulenger, G. A. : A List of Snakes from Mesopotamia. *J. B. N. H. Soc.* xxvii, No. 2, 1920.

⁴ Smith, Malcom. : Monograph of the Sea Snakes, 1926.

⁵ Gray. : Catalogue of Snakes in the British Museum, 1849.

bore the faintest suggestion of a short central keel. The colour was dull olive barred with black dorsally. It was decided that the specimens approximated more to *Enhydrina schistosa* and they were so labelled.

An engineer from one of the dredgers employed at the bar of the Shatt-el-Arab off Fao told me that it was not uncommon for sea-snakes four feet in length to be emptied out in the contents of the sludge buckets of the dredger. He said that these snakes were green with black cross-brands and were known to the native crew as being poisonous.

The following additional species of Hydrophiidae have been recorded from the Persian Gulf: ¹

Thallasophina viperina Schmidt.—Persian Gulf and Muscat.

Hydrophis spiralis Shaw.—Persian Gulf, Gangestum and Muscat.

Hydrophis cyanocinctus Daudin.—Persian Gulf.

Hydrophis ornatus Gray.—Muscat.

Hydrophis lapemoides Gray.—Persian Gulf and Jask.

Lapemis curtus Shaw.—Muscat.

Microcephalophis gracilis Shaw.—Persian Gulf and Gulf of Oman.

Family: ELAPIDÆ

Naja morgani, Moquard.—The Hoodless Cobra.

Synonyms.—*Atractaspis wilsoni*.²

Vernacular Names.—It shares the names 'Urbid' and 'Abrid', that is, the 'black snake' with *C. jugularis* var. *asianus*.

The recorded distribution is Persia and Iraq. Specimens have previously been taken in Shaiba and 'Mesopotamia'.³

In 1928 and 1929 five further specimens were secured from Mosul³, Baqubah, Mandali, and Rutba in the Shamiyah Desert.

Locality	Size (ins.)	Ventrals	Caudals	Rows	Anal	Remarks
Mosul ...	12	185	46	21	1/1	Uniform black.
" ...	25	183	43	21	1	"
Baqubah ...	26.5	185	44	21	1/1	Purplish brown, belly paler.
Mandali ...	29	185	30+	23	1	Tail mutilated. One preocular, two post-oculars.
Rutba ...	22	182	45	21	1/1	Uniform black. "

¹ Smith, Malcom.: Monograph of the Sea Snakes, 1926.

² Wall, F.: *J. B. N. H. Soc.* xviii, p. 804, 1908.

³ Boulenger, G. A.: A List of Snakes from Mesopotamia. *J. B. N. H. Soc.* xxvii, No. 2, 1920.

In the six complete specimens the tail was a sixth to a seventh of the total length. There were invariably seven supralabials with the third and fourth touching the eye. The third also touched the nasal. Unfortunately the periocular scales were not noted in four specimens, nor were the caudals closely examined in any. These gave the impression in every specimen of being divided but a photograph in the writer's possession suggests that a number, six or so, of the more immediately proximal caudals were entire.

It is interesting to compare this cobra with *Wallerinnesia ægyptia*, Lataste¹ of which five specimens are known, all recorded from Egypt. Two only, however, are reputed to have their exact provenance known. These were caught on the Cairo-Suez Road. In 'counts', proportions and colouration the two species *N. morgani* and *W. ægyptia* appear to more or less agree. There remains however the generic obstacle in the absence of small teeth behind the fangs in the *Wallerinnesia* type specimen. Mr. H. W. Parker of the British Museum was good enough to examine the type specimen and was of the opinion that if a further examination of *Naja morgani* revealed an agreement with *Wallerinnesia* in other externals, such as keeling of the posterior dorsal scales; proportion, numbers and distribution of the perioculars; and the variation in the division of the caudals, then a dental dissection ought to be made to verify the generic validity of *Wallerinnesia*. I am awaiting with interest the opportunity to again examine specimens.

Naja morgani is apparently uniformly distributed throughout Iraq and is not uncommon. It may be found in various habitats and is by no means shy. The young Mosul specimen was picked up on a tennis court. The adult emerged daily from a hole in the gateway of the Mosul Civil Hospital to glide about amongst the waiting patients. This went on for months and the snake enjoyed a certain status as a sort of 'divan habitué' until one day, a request for snakes having been received, he was killed, bottled, and sent in. The Baqubah specimen was brought up alive from a bricked well by an enthusiastic chauffeur. He was passed round an appreciative and inquisitive circle before being killed, pickled, and passed on. Though he hissed very angrily he is said not to have attempted to bite, even when freely handled. The Mandali specimen was taken on a track near cultivation and the Rutba specimen came from the desert. I know of no records of snake-bite by this species or *W. ægyptia* but presume that its genus alone should be sufficient to procure it respect.

Family : VIPERIDÆ.

Sub-family : VIPERINÆ.

Vipera lebelina, Linnaeus.—The Levantine or Blunt-nosed Viper.

Synonyms.—*Vipera euphratica*,² *Daboia xanthina*.³

Vernacular Names.—In spite of the fairly frequent occurrence of this snake and of its reputation, I could not get hold of a name for it.

¹ Lataste : Le Naturaliste, p. 411, 1887.

² Martin : Proceedings Zoological Society of London, 1838.

³ Gray : Catalogue of Snakes in the British Museum, 1849.

Everyone north of Baghdad knew of it and could describe it. It was always spoken of as being deaf. On one occasion a Mosuli described it surprisingly well as 'a dangerously poisonous snake, with a thick body and a thin neck, a tail like a cigarette, of a brown colour, and blind and deaf'. In Cyprus the snake is known as 'Koufi', a Greek derivation meaning deaf. I understand that in ancient Assyria (Mosul and area) a word 'Kuppu' was used in application to a 'terrible snake'. In the Mosul area to-day an inquiry as to the 'deaf snake' would, I think, instantly bring descriptions of the Levantine Viper. However, I was unable to collect a definite name.

The distribution is from North Africa, Greece and Cyprus to the Levant, Transcaucasia, Iraq, Persia and North-West India. In Iraq, specimens have previously been recorded from Baghdad and Aushuru (?).¹ During 1928, 1929 and early 1930 seven more specimens were examined; all of them from places in the north-east of Iraq, namely Sulamainia, Mandali, Mosul, Baqubah, Jebal Hamrin, Qaragan and Barazan on the Greater Zab River.

Locality	Size (ins.)	Ventrals	Caudals	Dorsal rows	Remarks
Sulamainia ...	12	173	52	27	Very dark; young specimen.
Mandali ...	22	150	44	23	...
Mosul ...	24	181	48	25	Bit man, result recovery.
Baqubah ...	38	162	38	25	...
Jebal Hamrin ...	40	164	47	23	Bit man, result fatal.
Qaragan ...	25	176	53	23	...
Barazan (Greater Zab)	38	173	46	25	...

In all specimens the tail was about a seventh of the body length. The scales were invariably strongly keeled, the anal was always single and ten supralabials were constant. The colour ranged from dark olive in the smallest specimen, with clear cut darker markings, to pale grey or brownish grey with less defined markings in the largest specimens. The larger the snake the lighter the colour. The bellies always exhibited the characteristic viperine speckling.

Mr. J. Parlbay once spoke to me of having seen a snake answering in description to *V. lebetina*, travelling downstream in the Diyala River near Qaragan.

Vipera lebetina seems to be confined to the hills and broken country north-east of Baghdad. There is no record of *E. carinatus* thereabouts and only one of the nine *C. cornutus* recorded below for Iraq, came from this region. There are no other vipers occurring in Iraq. Out of seventeen cases of bite (viperine type) by unidentified

¹ Boulenger, G. A.: A List of Snakes from Mesopotamia. *J. B. N. H. Soc.* xxvii, No. 2, 1920.

snakes no fewer than fourteen came from this area as did also two cases in which the snake was identified as *V. lebetina*. It rather looks as though the majority of snake-bite accidents in Iraq are caused by this viper. If this is correct, then the mortality from its bite would be forty-four per cent, seven deaths in sixteen cases. This is a high percentage, but, that it is quite possibly of true significance is suggested by the widespread fear in which the 'deaf snake' is held in the country north and east of Baghdad.

It is spoken of as being deaf and blind on account of its sluggishness and torpidity by day, a characteristic also, I understand, of its congener the Indian Daboia, *V. russelli*. If shouted at or threatened with a stick it is said to show no perturbation whatever.

Cerastes cornutus Linnaeus.—The Horned Viper or Asp.

Vernacular Names.—'Efa' and an apparent corruption 'Al Fiyah' appear to be applied in Iraq to all noxious snakes, more particularly vipers, and most particularly to the Horned Viper. 'Qarna' and 'Um Grun' are also used referring to its horns and I have heard it discussed and described in the Muntafik Liwa as 'Um Jenaib' in reference to its peculiarity in coiling (i.e. moving) to a flank, with its head poised and threatening to the front. 'Abu Jenaib' is used of the local fresh-water crab.

The distribution is North Africa, Arabia, Palestine, Syria and Iraq. It is figured on the monuments of ancient Egypt, Babylonia, and Assyria. In Iraq previous records, six in number, all of hornless specimens, were from Basra and Shaiba.¹ In the period 1927-30, three more records were obtained, all of horned specimens. One from Nebr in the Muntafik area lived in the writer's possession for seven months. Another was responsible for a fatality in Dohuk, North of Mosul, and the third specimen came from Rutba, in the Shamiyah Desert.

Locality	Size (ins.)	Ventrals	Caudals	Rows	Remarks
Nebr ...	15	...	...	...	No counts done. Lived in writer's possession for over seven months.
Rutba ...	15	144	37	29	Anal single, supra-labials thirteen.
Dohuk ...	30	...	...	...	No counts done. Bit a man who died in 24 hours.

The characteristic flat triangular 'ace of spades' head was notable in both specimens seen. The Dohuk specimen was reported by the relatives of the bitten man as being about four-hand spans long, as having horns, and as having a thick body and a broad head.

¹ Boulenger, G. A. : A List of Snakes from Mesopotamia. *J. B. N. H. Soc.* xxvii, No. 2, 1920.

Incidentally this is the only record I know of in which death has resulted from *Cerastes* bite. The other eight specimens of this snake came from the desert plains to the south and west but I feel that the Dohuk fatality rings true and should be accepted although no doctor saw the victim alive, or the snake.

Echis carinatus Schneider.—The Saw-scaled Viper.

Vernacular Names.—None known of. Would probably be spoken of as 'El Efa.'

The distribution is from North Africa, Syria and Arabia to Iraq, Persia and India. In Iraq one has previously been recorded from Imam Hamza in the Diwaniyah area.¹ This was in 1924, the specimen being responsible for a fatality. Since that date four further cases of snake-bite have occurred in the same region. In three instances followed by recovery, the snake was identified as *Echis carinatus*. In the fourth case which terminated fatally the snake was not seen and although for various reasons I consider that the snake must have been an *Echis*, I do not record it as such here as this paper is intended to be more or less purely zoological and should take note only of snakes actually identified.

Locality	Size (ins.)	Dorsal Rows	Colour	Remarks
Imam Hamza ...	16	25 keeled	Characteristic broad arrow	Fatal bite.
Diwaniyah ...	...	No particulars recorded	...	Bite—recovery.
"	" "	...	" "
Khan Judwhal ...	...	" "	...	" "

It is notable that all these four specimens came from the Middle Euphrates and none from elsewhere in Iraq.

¹ Sinderson, H. C. : Snake Bite in Iraq. *Edin. Med. Journal*. Nov., 1924.

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The conclusions of this rather superficial survey may be conveniently tabulated as follows.

Species	Distribution in Iraq	Number of new specimens	Remarks
TYPHLOPIDÆ			
1. <i>T. braminus</i> ...	Basra	<i>Nil</i>	...
2. <i>T. vermicularis</i> ...	Riverain Iraq	2	New for Iraq
LEPTOTYPHLOPIDÆ			
3. <i>L. macrorhynchus</i> ...	Riverain Iraq	3	...
BOIDÆ			
4. <i>E. jaculus familiaris</i> .	Iraq including Kurdistan	8	Colour variety in Kurdistan
COLUBRIDÆ			
<i>Aglypha</i>			
5. <i>N. tessellatus</i> ...	Throughout Iraq excluding Kurdistan	15	...
6. <i>C. dahlia</i> ...	Baghdad area	2	...
7. <i>C. diadema</i> ...	Throughout Iraq including Kurdistan	12	Colour variety in Kurdistan
8. <i>C. jugularis</i> ...	Riverain Iraq	8	Var. <i>asianus</i>
9. <i>C. ravergeri</i> ...	Mosul	2	New for Iraq.
10. <i>C. ventrimaculatus</i> ...	Riverain Iraq	18	...
11. <i>L. diadema</i> ...	Western Iraq	1	...
12. <i>C. collaris</i> ...	Northern Iraq and Kurdistan	2	...
13. <i>C. coronella</i> ...	Western Iraq	1	...
14. <i>C. decemlineata</i> ...	North East Iraq and Kurdistan	3	New for Iraq. A mountain species?
15. <i>C. persica</i> ...	North East Iraq	<i>Nil</i>	Relationship to <i>C. collaris</i> ?
<i>Opisthoglypha</i>			
16. <i>T. fallax iberus</i> ...	Iraq excluding Kurdistan	8	Young darker than adults

Species	Distribution in Iraq	Number of new specimens	Remarks
17. <i>M. monspessulana</i> ...	Iraq and Kurdistan	9	Var. insignitus and Var. neumayeri
18. <i>M. molensis</i> ...	Southern Iraq	<i>Nil</i>	...
19. <i>P. schokari</i> ...	Western Iraq	1	...
HYDROPHIIDÆ			
20. <i>E. schistosa</i> ...	Persian Gulf. Possibly Shatt-el-Arab	4	No records of bite. New for Iraq.
ELAPIDÆ			
21. <i>N. morgani</i> ...	Iraq as far North as Mosul	5	No records of bite. Possibly related to <i>W. ægyptia</i> .
VIPERIDÆ			
<i>Viperineæ</i>			
22. <i>V. lebetina</i> ...	North East Iraq and Kurdistan	7	Two cases of bite—one death. Probably responsible for many more.
23. <i>C. cornutus</i> ...	Iraq as far North and East as Dohuk (Mosul)	3	One case of bite—one death. First horned specimens from Iraq.
24. <i>E. carinatus</i> ...	Middle Euphrates	4	Four cases of bite—one death.

FLOWER-BIRDS AND BIRD-FLOWERS IN INDIA.

BY

SALIM A. ALI.

(With four plates and four text-figures.)

Hermann Müller, one of the most noted pioneers in the study of the fertilization of flowers, summing up our knowledge on the subject, avers that although self-fertilization by itself may suffice for the propagation of organisms for an unlimited number of generations producing healthy and fertile offspring, yet, as has been proved by the researches of botanists, whenever plants which are the offspring of self-fertilization are opposed in the struggle for existence to the offspring of cross-fertilization, the latter have the advantage. Thus it becomes evident that all peculiarities which aid cross-fertilization will be retained and perfected by natural selection.

The importance of bees, butterflies and a host of other insects in the cross-fertilization of flowers is well known, but the significance of birds in the same capacity has been consistently underrated. It is a subject which has hitherto received no attention whatsoever from workers in India inspite of the vast opportunities the country offers for observation and study, and my purpose in writing this paper is merely to arouse a general interest in the subject, and broadly indicate its possibilities.

To my mind, this branch of research lies more within the sphere of the field ornithologist than in that of the botanist, and the reason is not far to seek. The ornithologist, even though he may know nothing whatsoever of botany, will seldom have much difficulty in collecting specimens of the flowers on which he has observed bird visits, and in having them identified subsequently. The botanist, similarly placed, will be left in doubt as to the identity of the visiting bird as it ceaselessly hops and flits about among the blossoms or darts off to another tree, and will seldom have the means at hand of getting a satisfactory determination of its species. The result will often be that the botanist's record will remain incomplete and, as such, valueless from the scientific point of view.

While it is but rarely that an ornithologist also possesses sufficient competence in botany to be able to conduct research of this nature without the aid of a specialist, and vice versa, an intimate co-operation between the two is clearly indicated for obtaining optimum results. Although this paper does not claim to be any more than merely casual notes of observations in the field, I could not have written it without constant help in identifications, suggestions and advice principally from the Rev. E. Blatter, S. J., but also from a number of other botanists with whom I have been in constant correspondence, to all of whom my best thanks are due.

I am also greatly indebted to Professor Dr. Otto Porsch of the Hochschule für Bodenkultur, Vienna, for kindly placing at my

disposal the separata of his recent excellent publications on Ornithophily from which I have taken the liberty to quote freely.

It must be borne in mind that the mere fact of a bird being casually seen on a flower is by itself no evidence of the fact that the flower is ornithophilous or that the bird is an agent in its cross-pollination. But if it is repeatedly observed that a particular species of bird is partial to a particular species of flower and frequents them regularly; that the object of its visits is obviously the nectar situated deep down within the flower-tube; that the structure of the corolla and the position of the essential organs—the stamens and the style—are such that in its endeavours to get at the honey, the head, breast or other portions of the bird's anatomy might reasonably be expected to come into contact with them, then alone can we have justification for assuming that that particular flower *may* be wholly or in part bird-pollinated. To prove the correctness of this assumption, it will further be necessary to secure the bird and subject its plumage to a microscopic examination for adhering pollen. As Neger points out in his excellent summary of Ornithophily (9) it is in a great measure due to the wild generalizations based on insecure premises made in the past that discredit has been brought on the value and importance of birds as agents in the cross-pollination of flowers, and it therefore now behoves workers to exercise special care and attention in the observations they record.

The most highly organized bird-flowers as we find them to-day present certain well-marked characteristics which serve to differentiate them in a general way from flowers fertilized by insects, wind or other agencies. The most important of these are:

(1) Their structure and pollenizing mechanism is such as to render the transfer of pollen possible only through visits of birds to the nectar.

(2) They usually possess bright and conspicuous colours such as crimson or scarlet, yellow, white, bright blue, also brown and others, which react on the keenly-developed colour-sense and sharp eyesight of the feathered visitors. Experiments have shown that red is the most attractive colour to birds.

It is also worthy of note that the colours of many bird-flowers are not infrequently reproduced in the plumage of their bird-visitors. I was particularly struck by this in the case of a Yellow-backed Sunbird (*Ethopyga siparaja vigorsi*) recently observed at Lingmala (near Mahableshwar) on the scarlet blossoms of *Hibiscus Rosa-sinensis*, whose breast and upper plumage harmonized with the brilliant colour of the flowers to perfection.

(3) The absence of scent is a feature of the most highly adapted bird-flowers. This dovetails as it were with the completely absent or extremely ill-developed sense of smell in birds, especially in the order *Passeres*.

(4) Their richness in honey production. The nectar which is rich in carbohydrates, is highly nutritious and provides both meat and drink to the birds. Their visits to flowers are without doubt largely with the object of quenching their thirst. The origin of the nectar-eating habit is clearly suggested in the habit, commonly noticeable in arboreal birds, of quenching their thirst from dew or rain-drops



1. Drongo (*Dicrurus macrocercus*).



2. Dhyal (*Copsychus saularis*).



3. Red-vented Bulbul (*Molpastes cafer*).



4. Striped Squirrel (*Funambulus tristriatus*).

collected on the foliage of trees. In the warmer regions of the globe where there is often a scarcity of water in the hot-weather months, the nectar of flowers constitutes a great boon to thirsty birds. It will be seen from the following list that the flowering season of a great many species closely corresponds with the season of drought i.e. between the cold weather and the S.-W. monsoon.

(5) True bird-flowers may, as a rule, be recognized by the absence of broad 'rims' or lobes which serve as an alighting place to visitors in entomophilous flowers, but hinder the access of birds to the nectar.

There are a great many flowers with structure and characteristics intermediate between typical bird- and typical insect-flowers. Among Indian species, for example, *Amherstia nobilis*, *Poinciana regia* and *Poinciana (Cæsalpina) pulcherrima* show adaptations for ornithophily as well as for entomophily, and are visited both by birds and by insects. There are many species of flowers which in their native land are fertilized by insects as well as by birds, while even these may be fertilized in one locality exclusively by birds and in another exclusively by insects. In Natal, for example, according to Scott-Elliot, the pollen of *Musa* is usually transferred by the *Cimnyridæ*, and more rarely by bees, whereas in Mauritius on the contrary, bananas are said to be pollinated by insects. While a great many flowers are visited and doubtless also fertilized to some extent by birds (the magnitude of whose services is on the whole incalculable), it is not unlikely that in India at least the number of species dependent for their pollination *exclusively* upon birds is comparatively small.

As regards the origin of ornithophilous flowers, one comes across assertions in literature so often to the effect that these have evolved from entomophilous forms that it would appear as though this were an established fact. Schnarf (15), in particular, often refers to flowers transitory between entomophilous and ornithophilous forms. Werth (21) points out that, as long as statements of this kind are confined to specific examples and not implied in a general way, one can have nothing against them, and after discussing various species he comes to the conclusion that although certain ornithophilous flowers can be admitted to have evolved from entomophilous forms, in others (e.g. some *Erica* species) the process can clearly be demonstrated to have been the reverse. Fossils of ornithophilous forms have been discovered dating back to a geological period where flowers with as yet only the first entomophilous adaptations are met with. Further, Werth mentions that among the Angiosperms, wind-, insect- and bird-flowers, as well as well-established flower-insects and flower-birds are all met with at the same time in the lowest chalk stratum of the earth.

In our own day bird-flowers are distributed throughout the tropics and sub-tropics of both hemispheres; in other words the number of ornithophilous flowers is greatest where representatives of the most highly-organised flower-birds occur: the Humming-Birds (*Trochilidæ*) and Sugar-Birds (*Cærebidæ*) in tropical America, the *Nectariniidæ*, *Dicaidæ* and *Zosteropidæ* in the tropics and sub-tropics of the Old World, and the *Meliphagidæ* and *Trichoglossidæ* in the Australian Region.

There has been a tendency to attribute the object of birds' visits to flowers solely or chiefly to a search after the attending insects, and the importance of the honey has been unwarrantably belittled. As I have pointed out elsewhere (*J.B.N.H.S.*, vol. xxxv, pp. 145-46), there seems no reason for doubting that the visits of specialized birds to the flowers of their choice may be exclusively in quest of the nectar. As mentioned before, flower-nectar is rich in carbohydrates and provides excellent nutriment, and the fact that Sun- and Humming-birds have been kept in captivity for weeks on end on an exclusive diet of syrup, proves the comprehensiveness and all-sufficiency of this class of food. That birds may, in addition, supplement their diet by any little insects that happen to be present on the flowers, is of course self-understood. With a little practice in the field, it is not difficult to determine whether a bird's quest on a flower is the nectar or the attending insects. The deliberate and systematic probing of the bill deep into the corolla-tube for nectar is a process quite distinct from the casual hunt for insect visitors. For instance, no one could fail to differentiate between the behaviour of an Iora on the flowers of the Coral Tree and that of a Myna. The former visits the flowers mainly, if not entirely, for the little insects, while the latter is a confirmed nectar-bibber.

Having indicated the chief peculiarities of the true bird-flowers, it will not be out of place to mention some outstanding characteristics of the typical flower-birds. I confine my remarks to our Indian representatives, the pride of place amongst whom must unquestionably go to the *Nectariniidæ* (Sun-birds). On account of their resplendent plumage, specialized bill and tongue, and their lively and flower-haunting habits, this group has been called the Humming-birds of the Old World. Among all the Passerine birds with a honey diet, the *Nectariniidæ* (along with the *Meliphagidæ*, *Cærebidæ* and many of the *Drepanididæ*) possess the most highly organised 'mouth-parts'. The bill is long, slender, decurved and more or less cylindrical. The edges of the tongue are rolled upwards and inwards

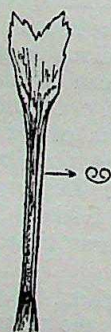


FIG. 1.
Tongue of *Leptocoma*
zeylonica.

and meet to form a closed tube which functions as a suctorial organ, and usually terminates in a bifurcation (Fig. 1). The tongue, moreover, is extensile and capable of being projected much beyond the tip of the bill. I once watched a *Leptocoma lotenia* which seemed to have a long slender and wriggling worm held endwise in its beak. The glasses showed that this was the bird's tongue which it shot out several times and as rapidly withdrew, remarkably after the fashion of a snake. The organ projected quite a third to one-half the length of the bill beyond the tip of the latter. All the members of this family are furnished with tongues following this characteristic pattern, and eminently adapted for a diet of nectar from flowers.

The families next in importance in India as flower-frequenterers are the *Zosteropidæ* (White-eyes) and the *Dicaeidæ* (Flower-peckers)

whose tongues show half-way stages between the normal general-purpose pattern possessed by the majority of Passerine birds with omnivorous diet, and the highly specialized suctorial organs of the *Nectariniidae* whose diet comprises for the most part of nectar. The edges are only slightly curved in to form an open trough or gutter. In *Zosterops palpebrosa* it terminates in bristles for about $\frac{1}{3}$ its length, divided into two 'brushes' (Fig. 2) while in *Dicaeum erythrorhynchum*, the tip presents bifurcated half-tubes. In the Thick-billed Flower-pecker (*Piprisoma agile*), the tongue is triangular and broad at the base, short and cartilaginous except at the bifid tip. The curled edges are almost, if not entirely, absent and this together with the stout finch-like bill makes its possessor comparatively a casual visitor to flowers. In both these families the tongue, as in the *Nectariniidae*, is extensile.

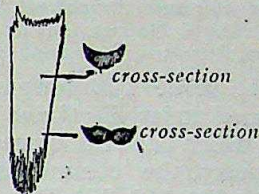


FIG. 2. Tongue of *Z. palpebrosa* (Nat. size about 12 mm. long.)

Besides these specialized families, it will be seen from my list of bird-frequented flowers that there are a great many heterogeneous species which, without being specially equipped, are nevertheless regular nectar-seekers. In order to show at a glance the birds observed as habitués of flowers, I append a separate list at the end giving the Orders, Families and Species of such. The lists are the result of observations relating to the past three years during which I have been able to pay somewhat more than passing attention to the subject of Ornithophily, especially in Western India and the Bombay Deccan. The records are principally based on direct observations in the field through powerful glasses and although they furnish good circumstantial evidence, it is clear that in a few instances only (where the microscope has revealed pollen adhering to bill or surrounding feathers—indicated by asterisks in the following lists) are they of a sufficiently experimental nature to be considered more or less conclusive in their application.

LIST OF FLOWERS OBSERVED TO BE REGULARLY FREQUENTED BY BIRDS.

Order : MALVALES

Family : MALVACEÆ

1. *Bombax malabaricum*, DC. (Coloured Plate, *J. B. N. H. S.*, xxxiii 632).

Flowers crimson, large and numerous, growing in clusters on short thick stalks towards the ends of the branches. They appear before the new leaves, and the bareness of the tree at this period provides excellent opportunities for the observation of bird-visitors.

Petals fleshy, bent back, 3-6" long. Stamens pink, flattened, more than 60, united only at base to form five bundles, each containing 9-12. There is an additional inner bundle of 15 stamens of which

the 5 innermost are longest. The conical ovary tapers at the apex to form a club-shaped style which exceeds the stamens in length and ends in 5 slender processes, the stigmas. The anthers are long and brown.

Flowering Season: January to March.

Distribution: Indigenous throughout India and Burma except in the most arid tracts. Sub-Himalayas upto 3,500' (cultivated at 6,000 in N.-W. Himalayas) very common throughout the Bombay Presidency, Satpuras and all forest districts of Madras Presidency. Also Ceylon, Yunnan, Cochin-China, Tonkin, Java, Sumatra, Queensland and North Australia.

Visitors: The flowers are visited by all the species of birds mentioned under *Erythrina indica* with the exception of ¹ 18, 21, 39 and 46 which have not come under my notice so far. In this part of the country, the commonest visitors seen are Nos. 1*, 2*, 10*, 11*, 14*, 22*, 25*, 26*, 27*, 29*, 41*, 42, 43 and 44. I would, without hesitation, assign the pride of place to No. 25, *Pastor roseus* L. In an area where both *Erythrina indica* and this species are flowering, practically side by side, it has invariably been my experience that the Cotton Tree is by far the more patronized by this bird, while the Babbler (*Turdoides somervillei*) exercises his preference in favour of the Coral.

While the Bombax is in flower, the diet of the Rosy Pastor in many parts of the country seems to consist more or less exclusively of the nectar, a thick sticky sugary juice in the 'cup' at the base of the filaments. It comes to the trees imbued with a sense of ownership and launches the offensive against every other visitor to the blossoms, often rushing 15 or 20 feet across from the other side of the tree where it is feeding, to do so. Most small birds fly before the fury of its onslaught, often being driven from branch to branch. Even the indomitable King Crow has to give way. Alone in the Mynas *Acridotheres tristis* and *Æthiopsar fuscus* does the Pastor find its match. They, of all the feathered company, pay scant heed to its demonstrations. It is common to see a Pastor angrily drooping its wings and spreading its tail (flicking it sideways) perched in a truculent manner shivering with rage and swearing its heart out within a few inches of a completely unperturbed Myna busy on the flowers. At times the chivvying gets beyond the Myna's power of endurance whereupon it goes for the Pastor causing it to depart precipitately. After it has had its fill of the nectar, the Pastor will sometimes occupy itself solely with playing 'Dog in the Manger.' It sits on a branch and utters its bellicose *chit, chit, chit* varied by occasional attempts at a screeching song. When thus engaged, it usually takes shelter from the sun by getting into the shade of some branch. From this vantage point it continually launches sallies against Sunbirds and Striped Squirrels feeding from neighbouring flowers, twitching its wings threateningly. The nectar seems to act as a laxative and the bird excretes once in every three minutes or so. It feeds from the flowers all day long, but especially in the mornings before 11 o'clock. After a spell of assaults, angry chattering and 'song,' there are invariably little

¹ Numerals refer to list of birds under *Erythrina indica*.



1.

(1) Bombay Babbler (*Turdoides somervillei*) and (2) Jungle Crow (*Corvus leuclantii*) on *Erythrina indica*.



2.



3.

(3) Rosy Pastor (*Pastor roseus*) and Purple-rumped Sunbird (*Leptocoma zeylonica*) on *Bombax malabaricum*.
(Photos by Author).



4.

pauses of silence when all the company suddenly becomes dumb and motionless. The arrival of some new visitor soon puts an end to the truce however, and chasing and chattering are resumed once more. Sunbirds appear to act as 'honey guides,' for as soon as one is driven off a flower, the Pastor is sure to probe into the corolla itself. For a photographer who has focussed his camera on a suitable low-hanging bunch of flowers for a Pastor, there is nothing more promising than the visit of a Sunbird. In nine cases out of ten the Sunbird will promptly be replaced by the irate Pastor!

In a grove of *Bombax* trees in bloom near Kāmat Village (Alibag Taluka), there were two examples with flowers of a lemon-yellow colour. It struck me as particularly strange at the time, that although there was continuous hustling and rivalry among the birds on the normally coloured flowers, those of the yellow variety remained practically unattended, save for an occasional Sunbird that had been hunted off the crimson flowers. That the yellow flowers also contained nectar was evident on examination, but what the precise factor was that made them distasteful to the visitors I was unable to ascertain. My impression further is that in due course (as a consequence ?) when the pods made their appearance, a smaller number was noticeable on these two trees than on their normal neighbours, though I have no statistical evidence. I consider this point most interesting and worthy of a proper investigation. The yellow variety of *Bombax malabaricum* is certainly not common, and it would be interesting to know if this is merely a temporary aberration brought about by some physiological defect in the tree.

In addition to birds I have regularly found the Striped Squirrels (*Funambulus tristriatus* and *F. pennanti*) on the flowers licking the nectar and biting the petals. Troup observed *Ratufa gigantea* eating the flower-buds in quantities, and even Martens (*Martes flavigula*) visiting the flowers in search of nectar. It is probable that these mammalian visitors also contribute towards the cross-pollination of *Bombax* flowers.

[It is surprising that Knuth (7) mentions nothing regarding the pollination of this species, although, as Porsch (14, Part I) points out, Swinhoe recorded the visits of *Cinnyris rhizophoræ* Sh. to these flowers in the island of Hainan long ago.]

2. *Bombax insigne*, Wall.

Flowers larger than in the preceding species, somewhat paler red in colour. Often scarlet or white. Stamens 400-600 arranged in bundles, not so distinctly as in *malabaricum*. Style longer than stamens, terminating in 5-lobed stigma.

Flowering Season : January to March. In the Kolaba district this year 1931, I noticed the flowers early in January, before *malabaricum* had commenced to blossom.

Distribution : Burma, Pegu, Andamans. Common in Western Ghats from the Konkan southwards; also Deccan and Anamalai Hills.

Visitors : Almost all the species of birds recorded under *malabaricum*. Also Striped Squirrels.

3. *Hibiscus Rosa-sinensis* L.

Flowers: Large bright scarlet or crimson, 4-5" across, with a projecting red column of stamens and pistil.

Flowering Season: Throughout the year.

Distribution: Said to be a native of China and Northern India (?) and to have been in cultivation throughout Malaysia and Polynesia before Europeans came east. Cultivated in gardens throughout India.

Visitors: The conspicuous flowers, dazzling in the sunlight are beloved of the Sunbirds who visit them regularly. The commonest visitors in the Kolaba District (N. Konkan) are *Leptocoma asiatica* and *L. zeylonica* and sometimes also *L. tolenia*. At Panchgani (4,400 ft.) in the Western Ghats, I have commonly observed *Leptocoma minima* on the flowers, while at Mahableshwar (4,500 ft.) in more afforested country, *Aethopyga s. vigorsii* is a constant visitor.

In my experience, to get at the nectar all these species bore tiny holes with their bills at the base of the corolla, just above the calyx. Such 'short-cuts' have been described by Tiwary (19, 20) in the case of *Sesbania grandiflora* and *Tecoma radicans* and by Porsch (12) in the case of many flowers in Buitenzorg Gardens, Java, including a *Hibiscus* of which he unfortunately does not mention the species. According to Lewis Bonhote the Sugar Bird (*Careba bahamensis* Rchb.), also bores holes in the calyx of *Hibiscus* flowers in the Bahamas to get at the honey. This habit obviously does not help to promote cross-pollination, and I cannot conceive of these birds functioning as important pollinating agents as has often been asserted by various writers. I have, however, occasionally seen *L. asiatica* and *L. zeylonica* hovering in front of an open flower to get at small insects within, and it is possible that in so doing, some pollen may accidentally adhere to the feathers and be transported to the stigma of another flower. If such a thing does occur, it can, in my opinion, only be exceptional. The plant has never been known to set seed in India (save for one isolated record which does not say whether the seeds were fertile), and Prof. N. K. Tiwary of the Benares University who has investigated its life history, informs me that this is due to some defect in its gametes.

Neger (9) in a list of species whose ornithophilous adaptations are 'beyond dispute' includes *Hibiscus Rosa-sinensis*. Werth (21) found the beautiful red flowers of this plant in Zanzibar to be visited by the Sunbird (*Cinnyris gutturalis*) and considers it to be ornithophilous, while Porsch (14, pt. i, p. 221) states that the genus *Hibiscus* contains in its large-flowered species quite a series of highly organized bird-flowers.

In view of the fact that all these authors take it for granted, more or less, that the flowers of *H. Rosa-sinensis* are fertilized by birds, it is presumable that in the countries to which they refer they have ascertained the plant to produce fertile seed. This however is a point on which confirmation is desirable.

Besides, though the flowers may occasionally be pollinated by hovering sunbirds in the manner I have above described, if *H. Rosa-sinensis* was indeed such a highly adapted bird-flower as Neger believes it to be, we should certainly expect a diminution in the size

of the petals or lobes which at present constitute a broad alighting place for insects but are at the same time a distinct hindrance to birds in legitimate access to the nectar.

The need of further observation and investigation is indicated before we can accept the ornithophilous nature of the flowers of this plant. In India certainly all the evidence is, if anything, opposed to such a presumption.

4. *Thespesia populnea*, Corr. (Coloured plate, *J.B.N.H.S.*, xxxiv, 274).

Evergreen tree 30-50 ft. high with heart-shaped pointed leaves resembling those of the Peepal (*Ficus religiosa*). Flowers single or in pairs, 3-4" across. Pale lemon-yellow with deep maroon centre. Finely crinkled petals set in cup-like calyx. The long style grows through a tube decked with a cluster of golden-headed stamens. It is crowned with a club formed of 5 close-set stigmas.

Flowering Season : Throughout the year, particularly at the beginning of the cold season.

Distribution : 'Tropical shores of Bengal, Ceylon and both Peninsulas. Tropical Asia, the Pacific Islands and Africa' (Hooker). Along the beach and tidal forests from Konkan southwards. Coasts of Chittagong and Andamans.

Visitors : I have regularly observed *Leptocoma asiatica* and *L. zeylonica* taking short-cuts to the nectar by boring with their bills at the base of the yellow crepe-paper-like corolla, just above the calyx. The birds frequently hover in front of an open flower for attending insects (or pollen?) and may occasionally assist in transporting ripe pollen in the manner referred to under the preceding species, as the structure of the flowers and the position of the essential organs is very similar in both. This plant produces seed freely, but to what extent birds are responsible for the fertilization of its flowers, needs to be investigated.

Family : STERCULIACEÆ

5. *Sterculia colorata*, Roxb. (Coloured plate, *J.B.N.H.S.*, xxxv, 525).

A large tree, trunk erect, bark ashy, branches spreading. Flowers in numerous short terminal panicles, tubular, orange- or reddish-brown in colour. Calyx $\frac{3}{4}$ ", tube 4 times longer than the rounded rather obtuse lobes, downy outside, pilose within. Style recurved; the stigma over-tops the stamens and protrudes beyond the lobes. (Plate IV, 2).

Flowering Season : March to May. Tree leafless when in flower.

Distribution : 'Eastern Bengal, Pegu, the Western Peninsula and Ceylon' (Hooker).

Visitors : On March 28, this year (1931) my attention was drawn by Mr. C. McCann to a bare tree in flower near Bhandup (Salsette). I observed a Sunbird (*Leptocoma zeylonica*) hopping about from one cluster to another, probing into the tubular flowers with its bill. While we watched, a *L. asiatica* also arrived on a neighbouring tree and started off on the same quest. An examination of the flowers, about 1" long and hanging in clusters from the ends of the bare

branchlets, showed that the 'rim' is considerably reduced, and much clear nectar is present within, at the base of the corolla tube. From the position of the essential organs it is evident that the flowers are well adapted for pollination by the *Nectariniidae* and the *Dicaeidae*, and there seems little doubt that these families play a considerable part in this vital process. Since then I have had several opportunities of confirming my observations, and have also followed through glasses a Flower-pecker (*D. erythrorhynchum*) eating nectar from these flowers.

Order: GERANIALES

Family: BURSERACEÆ

6. *Garuga pinnata*, Roxb.

A tree 30 to 40 feet. Flowers .25" long, yellow, in large pubescent compound spreading panicles.

Flowering Season : February to May (Talbot).

Distribution : 'Throughout India, and from the Jumna eastwards to Burma and southwards to the Nilgiris and Tenasserim; ascending to 3,000 feet in the Himalayas. Malayan Archipelago, Philippines' (Hooker).

Visitors : I have observed *Zosterops palpebrosa* and *Leptocoma asiatica* on the flowers, and on one occasion (near the Tulsi Lake in Salsette, March 3, 1929) a party of Rose-finches (*Carpodacus erythrinus roseatus*) were seen feeding from them. A male shot from this flock had pollen adhering to his forehead and upper breast, and nectar dripped freely from the bill when the bird was held up by its legs. It is very probable that besides the species noted, many others also visit the flowers which are rich in honey production. It also seems very likely that the birds assist in cross-pollination.

Order: SAPINDALES

Family: MORINGACEÆ

7. *Moringa oleifera*, Lamk. The Horse-radish or Drumstick.

A small tree, bark corky, wood soft, root pungent. Flowers in dense masses, creamy-white reminiscent of orange blossoms. Pedicelled, 1" in diameter, honey-scented.

Flowering Season : Various. In Konkan principally November-December. Hyderabad (Deccan) noted in March-April.

Distribution : Said to be a native of the forests of Western Himalayas and Oudh. Cultivated elsewhere throughout India and in various tropical countries.

Visitors : Wherever a tree is in flower—in a garden, some old village site or within the precincts of a populated village or hamlet, or even in the busiest and most crowded part of Bombay City such as Bhuleshwar or Pydhownie—it is invariably attended by the Sunbirds *Leptocoma asiatica* and *zeylonica*. In areas where other species of this family are common, the flowers are doubtless visited by them also.

Leptocoma asiatica and *L. zeylonica* may be seen on the flowers at all hours of the day, commencing almost at dawn though commoner and more noisy after the sun is well up—hopping from cluster to



1.

(1) Common Myna (*Acridotheres tristis*) and (2) Jungle Myna (*Æthiopsa fuscus*) on *Bombax malabaricum*.



2.



3.

Leptocoma erylonica on *Loranthus longiflorus*.



4.

Leptocoma astatica on *Calotropis procera*.

(Photos by Author).

cluster or darting from one tree to the next, hanging upside down and clinging to the branchlets in all manner of acrobatic positions in order to get at the nectar. There is much singing and display of vivacity, and frequent mock-battles ensue between the individuals of different pairs or species as one tries to oust the other from a specially coveted flower cluster.

Besides the Sunbirds, the flowers in the Konkan are largely attended by the butterflies *Aristolochia aristolochia* (black and red) and *Delias eucharis* (yellow and red) the former being by far the commoner. These are generally absent in the early mornings, but largely in evidence in the warmer parts of the day, especially on trees exposed to the sunlight. The *Aristolochia* butterfly often makes a feint at a Sunbird to dislodge him from a coveted flower-bunch and puts him to flight, itself presently returning to reap the fruits of its victory!

Another insect visitor frequently seen on the Drumstick blossoms is the humble-bee, *Xylocopa (amethystina?)* which doubtless also assists in the cross-pollination of the flowers.

Although the structure and other characteristics of the Moringa flowers do not conform to the truly ornithophilous type, I think there can be no doubt that Sunbirds play a considerable part in their pollination in India.

Knuth mentions that the flowers have a great attraction for Humming and Sugar-birds¹ in the regions where both bird and plant occur together.

In the Bahamas the Sugar-Bird *Cæreba bahamensis* Rehb. is said to be in constant attendance on the blossoms of a large, all-year flowering species of Moringa.

Order : ROSALES

Family : LEGUMINOSÆ

'In this family' according to H. Müller (3, p. 220) 'the essential organs are freely exposed. The petals or the stamens, or both together, attract insects'.

In India eight indigenous species of the genus *Erythrina* have been observed, all with red flowers. Two more have been introduced, viz., *E. Crista-galli*, L. and *E. Blakei*, Hort.

8. *Erythrina indica*, Lamk. (Coloured plate *J. B. N. H. S.*, vol. xxxiii, p. 624).

Prickly tree with spreading branches. Leafless when in flower. Flowers large, brilliant scarlet, arranged in racemes at tips of the branches. Corolla composed of five petals: an erect oblong standard which narrows at the base into a claw, two small wing-petals and two almost similar-sized keel petals of a distinctly darker hue. The wing petals partially enclose the keel. The stamens protrude for almost their entire length; they are united into a bundle at the base. Higher up the tenth stamen is distinct and free. The margins of the carina (keel) tightly overlap, and together with the closely-fitted standard form

¹ The Sugar-Birds (*Cærebidae*) contain about 75 species divided into 11 genera, and are amongst the most important pollinators of bird-flowers in Tropical Central and South America and neighbouring islands.

a conical sac at the basal region which is full of nectar secreted by the glands situated at the base of the gynœcium. The exudation of nectar is profuse; I have obtained seven drops and more from a single sac, and as the same flowers are visited by successive visitors, it is evident that the supply is quickly replenished.

Flowering Season : February to May. In the Konkan by the middle of April most trees have finished flowering.

Distribution : 'Reported to be indigenous inland in deciduous forests of Thana, the Konkan, N. Kanara and Malabar, and from the Sunderbans along the coast through Arakan, Pegu, Tenasserim, the Andamans, Nicobars, Java, Polynesia' (Blatter).

Visitors : One of the most familiar and gorgeous features of the Indian countryside when in flower, the *Erythrina* becomes the rendezvous of almost every species of arboreal birds of the surrounding locality. Its branches rock and sway as the eager nectar-bibbers hop from one flower-cluster to another throughout the livelong day, and great noise and bustle prevails. Birds appear most busy between sunrise and about 11-30. There is usually a break from this hour to about 3 p.m.—during the hottest part of the day, after which the company gradually re-assembles. I have observed the following species eating nectar from the flowers. Those marked with an asterisk have been shot and ascertained by means of a tube microscope to be carrying pollen on the feathers of their forehead and/or throat.

1. *Corvus macrorhynchos**—Regular frequenter on the countryside.
2. *Corvus splendens**—do. also within town limits.
3. *Dendrocitta rufa*—Occasional.
4. *Turdoides terricolor*—Only once seen, but species uncommon in areas to which my observations have been confined.
5. *Turdoides somervillei**—Perhaps the most common visitor. Invariably present.
6. *Chrysomma sinensis**—Frequent.
7. *Dumetia albigularis**—Not uncommon where tree is in suitable locality.
8. *Chloropsis jerdoni**
9. " *aurifrons davidsoni** } —Both these are regular attendants but not common. They are very jealous of other visitors, constantly attacking and driving them off the flowers.
10. *Molpastes cafer**—Regular and very common.
11. *Elathea jocosa**—Regular and very common.
12. *Ægilthina tiphia*—Only once definitely seen eating nectar. Probably visits flowers more in search of attendant insects.
13. *Pycnonotus luteolus**—Common.
14. *Merula nigropileus**—Regular, but seems to prefer *Bombax*.
15. *Copsychus saularis**—Males singing from nearby trees frequently visit the flowers at intervals to have a sip of the nectar.
16. *Dicrurus macrocerus**—Very common. Invariably present on flowers singly or in pairs. Jealous and bellicose, attacking and driving away other visitors from its proximity.
17. *Leucocirca pectoralis*—Not seen probing into flowers. Probably attracted by attendant flies.
18. *Tchitrea paradisi*—Seen only once. Probably in quest of flies.

19. *Muscicapula tickelliae* } —Frequently seen on the flower-laden
20. *Hypothymis azurea* } branches, but not probing for
- nectar. Like the other Flycatchers, insects are probably their
- objective, and their importance as pollen-carriers can only be negli-
- gible, if at all.
21. *Lanius schach erythronotus*—Not uncommon, but only once
- seen probing into a flower. Probably after insects, or using leafless
- tree as observation post.
22. *Orthotomus sutorius**—Common.
23. *Prinia socialis*— do.
24. *Prinia inornata*— do.
25. *Pastor roseus**—Frequent visitor, but far more partial to
- Bombax flowers. Very impatient of rival feasters, often attacking
- and driving them away.
26. *Acridotheres tristis**—Very common and regular. Arrives in
- parties of 5 or 6, the individuals hopping methodically from one
- flower-cluster to another, raising their beaks to swallow the
- nectar.
27. *Æthiopsar fuscus**—Very common and regular where occur-
- ring. A remarkable feature about this species is the tuft of feathers
- at the base of the bill which functions as an efficient pollen-brush.
28. *Temenuchus pagodarum**—Invariable visitor where occurring.
29. *Sturnia malabarica**— Do. do.
30. *Oriolus xanthornus*—Frequent, but not common.
31. " *oriolus kundoo*— do.
32. *Ploceus philippinus**—Commonly feeding on the nectar in
- parties of from 5 to 30. Also present on the trees when the flowers
- are in final stages of withering. To all appearances they also feed
- on the tender newly-formed pods.
33. *Passer domesticus*—Where the tree is situated within town
- limits or in or near a village, the flowers are commonly visited by
- this species.
34. *Gymnoris xanthocollis*—Frequent.
35. *Uroloncha malabarica* } —Occasional.
36. " *striata* }
37. *Carpodacus erythrinus roseatus**—Not uncommon.
38. *Psittacula krameri**—Very regular in some localities. Its
- habit of plucking off the flowers before reaching the honey, probably
- minimizes its usefulness as a pollinating agent.
39. *Eudynamis scolopaceus*—Only twice seen eating the nectar,
- when it was very shy. May be a more frequent visitor in out-of-the-
- way situations.
40. *Loriculus vernalis*—Occasionally seen in particular localities.
41. *Leptocoma zeylonica**—Invariably present throughout the day.
42. " *asiatica*— do. do. do.
43. " *lotenia**—Very common in some localities.
44. *Æthopyga siparaja vigorsi*—Frequent in localities where it
- occurs.
45. *Zosterops palpebrosa*—Not uncommon. Flocks work the
- flowers thoroughly.
46. *Brachypternus aurantius*—I was greatly surprised when I first
- saw this woodpecker eating the nectar, (24.4-31) but since then I

have observed it several times. I assured myself by means of field-glasses that its quest was actually nectar.

[According Hermann Müller the large flowers of *Carolinea* are pollinated by woodpeckers. He remarks that 'these birds may seek in the flowers for insects as well as the honey, but certainly for the latter, since when they peck oranges, as is frequently the case, they can of course expect only sweet juice and not insects' (Knuth, vol. i, p. 77.)]

In addition to the birds mentioned, I have found everywhere that the Striped Squirrels (*Funambulus tristriatus* and *F. pennanti* or *palmarum*?) are amongst the most regular frequenters of the Coral tree in bloom. They move about from one flower-cluster to another, biting into and sucking the nectar sacs. This quest often brings them into clash with a number of the more determined avian competitors such as the Drongo and the Rosy Pastor. At times they hold their own, while at others are forced to beat a hasty retreat, tail in air! Of several specimens shot, three examples showed pollen sticking to the fur of the head and lower neck, from which it is evident that they must also assist in cross-pollination to some extent.

Porsch suggests that perhaps bats may also be responsible for similar service to the Coral tree, but careful watching of several trees on a number of occasions (at Kihim) till 10 p.m. failed to produce any evidence in support of this. It is of course possible that further observation in other localities may show his surmise to be correct.

9. *Erythrina stricta*, Roxb.

Flowers orange-scarlet in racemes at tips of branches, shorter than in *E. indica*. Structure very similar to that in preceding species.

Flowering Season: January to May. In Salsette and the Konkan the flowers appear somewhat later than in *E. indica*; the tree is leafless upto the time of flowering.

Distribution: 'Assam, Manipur extending westward to Nepal, Chittagong, Burma, Orissa; deciduous mixed forests of N. Kanara and the Konkan.' (Blatter.)

Visitors: The majority of species mentioned under *E. indica* doubtless visit these flowers likewise, as the trees grow in more or less the same type of country and often side by side. Among those noted by me in passing were Nos. 1, 5, 8, 10, 11, 14*, 16, 22, 26, 41, 42, 43.¹ A *Merula nigropileus* shot off the flowers at Tulsi Lake (Salsette) had the forehead and upper breast clotted with nectar to which much pollen was adhering. There was also a quantity of loose dry pollen on the feathers.

10. *Erythrina Crista-galli*, Linn.

According to Delpino (8, p. 215), the crimson flower 'is inverted, the alæ are almost entirely aborted, and the carina forms a sheath covering the column and expanded below into a large honey receptacle. Since the stigma somewhat overtops the anthers, the visitors, probably humming-birds, touch first the stigma and then the

¹ Numerals refer to list of birds under *E. indica*.

anthers and so effect cross-fertilization.' In other words, the flowers closely resemble those of the two preceding species in their structure.

Flowering Season : In Bombay, March-April.

Distribution : This plant is a native of Brazil whence it has been introduced into gardens in this country.

Visitors : On a specimen in bloom in the Victoria Gardens, Bombay, I have observed the two common species of Sunbird, *Leptocoma asiatica* and *L. zeylonica* as frequent visitors, and Mr. D. S. Laud, the Superintendent of the Gardens, informs me that he has also often observed them on the flowers.

As regards seeding, Mr. Laud informs me that this year (March-April 1931) although the tree flowered moderately, he was able to secure only twelve seeds. Ten of these germinated and by 25th June, the plants were about 18" high. I consider it worthy of investigation why these flowers which appear in every way adapted for fertilization by Sunbirds (and other species) should produce such a scanty crop of seed. It will be seen from my notes further on, that there are many other apparently well-adapted exotic bird-flowers which in spite of the visits to them of suitable flower-birds, fail to produce seed in this country.

Werth points out that the flowers of *E. Crista-galli* can hardly be described as not exclusively ornithophilous just because humble-bees also occasionally help to pollinate them. Their colour and structure do not correspond with other humble-bee flowers, whereas they closely agree with ornithophilous forms.

In the Buitenzorg Gardens, Java, Porsch (12) observed *Cinnyris pectoralis*, *Æthopyga siparaja*, *Buchanga longa* Bp. = (*Dicrurus macrocercus* V.) and *B. cinerea* on the flowers of *Erythrina lithosperma*, Blume, which is largely cultivated in Java and grows wild in the mountains of Eastern Java. *lithosperma* of Blume is a synonym for *E. subumbrans*, Merr. an indigenous Indian species found in Burma in moist valleys near streams up to 3,000 feet. Also in Indo-China and Malaya. It flowers in January and February, the racemes of red flowers appearing with the leaves.

11. *Butea frondosa*, König. (Coloured Plate, *J.B.N.H.S.*, vol. xxxiii, p. 853).

An erect tree reaching 40-50 feet. Flowers grouped in threes along a velvety, dark olive-green stalk. In great profusion in stiff racemes about 6" long. Petals flaming orange with tinge of salmon pink produced by covering of silky white down. Corolla 1.5"-2". 5 petals; the standard about 1" broad, two smaller wing petals and a much curved, beak-shaped keel formed by the fusion of two petals. Stamens practically enclosed within the keel. There are ten, of which nine are united and one free. The curved style overtops the anthers and is suitably placed for fertilization by birds.

When in flower, the tree is either entirely leafless or has some leaves on the lower branches. The flowers chiefly cover the upper portions.

Flowering Season : End of January to March. In dry seasons the flowers appear somewhat earlier.

Distribution : 'Common throughout the greater part of India and Burma; in the Himalayas upto 3,000 feet, in South India upto 4,000 feet. Rare or absent in arid regions. Often gregarious.' (Blatter.)

Visitors: The flowers, which contain a large quantity of nectar, are invariably attended by birds, and the rocking and swaying of the branches as the visitors hop from one flower-cluster to another, gives away their presence from afar. The following species have been observed by me, though very probably a great many others visit the flowers besides.

<i>Corvus macrorhynchos</i> *	—	Regular and common.
„ <i>splendens</i> *	—	Do. do.
<i>Turdoides somervillei</i> —		Do. do.
<i>Acridotheres tristis</i> *	—	Do. do.
<i>Æthiopsar fuscus</i> —		Do. do.
<i>Sturnia malabarica</i> —		Do. do.
<i>Leptocoma asiatica</i> —		Do. do.
„ <i>zeylonica</i> —		Do. do.

[A related species, *Butea superba*, Roxb., a gigantic woody creeper with a stem as thick as a man's leg, found in Central and South India and Burma, will probably also be found to be ornithophilous. So far, unfortunately, I have not had an opportunity of investigating this species, but the structure of its gorgeous orange-scarlet flowers which crowd the leafless branches between March and April, strongly suggests the probability. They are considerably larger than those of *Butea frondosa*.]

12. *Poinciana regia*, Bojer. (Coloured Plate, *J.B.N.H.S.*, vol. xxxiii, p. 851).

Large deciduous tree 40–50 feet with spreading branches and very handsome feathery leaves. Brilliant scarlet blossoms arranged in immense racemes at the ends of the branches. Each flower is composed of five petals of which four are scarlet while the fifth, the standard petal, is slightly larger in size and much variegated with yellow, white and red. They emerge from between five fleshy scarlet-faced sepals which form the calyx. The ten long stamens surround a slender green style which overtops them. The flowers measure about 4" across.

As Werth has pointed out, the flowers show adaptations for entomophily as well as for ornithophily, and are visited by both birds and insects.

Flowering Season: The hot weather; April–June.

Distribution: A native of Madagascar introduced into this country within the last 100 years (Blatter). Common in gardens and as a roadside tree in Western India.

Visitors: The birds I have definitely observed probing into the flowers for nectar are:

Leptocoma asiatica
„ *zeylonica*

[H. Winkler observed both this and the next species, *Poinciana pulcherrima*, to be visited by Sunbirds in the Kamerouns, Ledien in the Congo, and Knuth in Buitenzorg, Java.]

13. *Poinciana (Cæsalpina) pulcherrima*, Linn.

A shrub or small tree. Flowers orange-scarlet or yellow, much smaller than in *regia* and with very long and protruding stamens.

Flowering Season: In my experience, in the Konkan the tree is in flower throughout the year, though more abundantly during the latter part of the monsoon and the cold season.

Distribution: Universally cultivated through India, and elsewhere in the tropics; the native country is not clearly known. (Hooker.)

Visitors: The flowers are largely visited by Sunbirds. *Leptocoma asiatica* and *L. zeylonica* may be almost invariably seen on them at all hours of the day. The nectar appears to form an important item of their dietary and in our garden at Kihim (last season), I observed that a female *L. zeylonica* sitting on her eggs about 30 yards distant from a Peacock-flower tree in bloom, usually made straight for the flowers when a break in the monsoon showers induced her to leave the nest for food. She was followed closely by her mate, and the pair would hop about from flower to flower clinging to the branches in every conceivable position and probing into the blossoms with their bills. On these occasions the cock was particularly lively and attentive to the hen, and between sips was constantly bursting into little snatches of song to the accompaniment of nervous flickings of his wings, as if to hearten her in her desultory task of incubation. The scene became particularly delightful to watch if the sun happened to peep out of the clouds and beam upon the dripping foliage and the resplendent plumage of the male.

The Rose-ringed Parakeet (*Psittacula krameri*) is also a frequent visitor to the flowers, but as it destroys them by biting through (and also eats the pods), its services in pollination are doubtful. Owing to the length of the protruding stamens and the position of the style, it is however possible that those of surrounding flowers may come in contact with its plumage while it is busy biting one, and thus effect a limited amount of cross-pollination.

The flowers are also visited by *Xylocopa* and various other insects, and like *P. regia* they show adaptations both for bird and insect fertilization.

Genus: BAUHINIA.

According to Hooker, this genus contains 37 Indian species occurring in India including Burma, Malaya and Ceylon, with flowers white, yellow, and variegated red and yellow. In the open blossom, as in all papilionaceous flowers, the vexillum is erect and acts as a sign-board for visitors—insects as well as birds. The style is usually recurved at the tip and projects somewhat beyond the anthers, making the flower's suitable for cross-pollination by bird-visitors.

14. *Bauhinia purpurea*, Linn.

Flowers sweet-scented, deep pink—sometimes white—in terminal or axillary short-peduncled, few-flowered corymbs. Petals 1.5" long × .5" broad; oblongate, with a long claw. Fertile stamens 3.4; filaments as long as the petals.

Flowering Season: September-November (Talbot).

Distribution : Sub-Himalayan tract from the river Ravi eastwards, ascending to 5,000 ft., Bengal, Burma, Central and Southern India. Cultivated throughout the Presidency, also probably wild in the dry forests of the Deccan and Konkan.

Visitors : The regular bird visitors observed by me, probing into flowers for honey, are the Sunbirds *Leptocoma asiatica* and *L. zeylonica*.

15. *Bauhinia racemosa*, Lam.

A small crooked bushy tree with drooping branches and bilobed leaves. Flowers whitish-yellow, .5" long in lax racemes 3-6". Their structure is well-adapted for fertilization by birds.

Flowering Season : March-June (Talbot).

Distribution : Throughout the Bombay Presidency. From Punjab and Garhwal to Ceylon and Pegu. Also China, Malay Isles and Timor.

Visitors : Our two common species of Sunbird, *L. asiatica* and *L. zeylonica* have been observed by me as regular visitors to the flowers.

[Altogether the genus *Bauhinia* contains about 250 species distributed over the tropics of both hemispheres. Three species occur in Australia and F. J. Bernay mentions in a letter to G. M. Mathews that *Psittentulus versicolor* Bonap., one of the Trichoglossidæ, feeds chiefly on the honey of *Bauhinia* flowers in Richmond (N. Queensland). In the case of two American species, Lindman has recorded visits to the flowers by Humming-Birds. (14, pt. ii, p. 190.)]

16. *Acacia arabica*, Willd.

Prickly tree with spiny branches and feathery leaves. Flowers bright yellow in globose fasciculate heads, about .5" in diam. Stamens free, indefinite, exserted. Style filiform; stigma minute.

Flowering Season : Rains, from June to October.

Distribution : Indigenous in N. Deccan including Berar and Khandesh; Rajputana, Gujerat and Sind. Several varieties.

Visitors : Among the birds regularly observed on the flowers are the Sunbirds, *Leptocoma asiatica* and *L. zeylonica*, and the Flower-pecker *Dicaeum erythrorhynchum*. Also occasionally *Ægithina tiphia*, but the latter probably in search of insects. In Sind, the race *brevirostris* of *L. asiatica* is a regular frequenter of the flowers.

17. *Sesbania grandiflora*, Pers.

A short-lived, softwood tree, 20-30 ft. high. Corolla 3-4" deep white (or in *Æschynomene coccinea* L. more or less deeply tinged with red). The structure of the flowers as in many of the Papilionatæ is well adapted for pollination by birds, and I have no doubt that to a large extent they are ornithophilous.

Flowering Season : November to February.

Distribution : 'Plains of the western peninsula (i.e. India proper); a doubtful native. Mauritius to N. Australia, but often cultivated' (Hooker).

Visitors: I have observed the following species of birds feeding from the flowers in the neighbourhood of Bombay and in the Konkan:

Corvus splendens
Molpastes cafer
Flathea jocosa
Leptocoma asiatica
 „ *zeylonica*
Acridotheres tristis
Psittacula krameri (Destroys flowers; value doubtful)

With the Sunbirds, I have repeatedly found that they bore tiny holes with their bills at the base of the corolla to get at the nectar, and the large number of flowers both on the ground and from the tree that were examined, almost invariably showed these 'short-cut' punctures. N. K. Tiwary has pointed out (19) that the Red-vented Bulbul, Rose-ringed Parakeet and the Myna also take these short-cuts to the nectar.

(The genus *Sesbania* Pers. contains about 24 species spread everywhere through the tropics and subtropics. Hooker mentions 4 as occurring within Indian limits.)

18. *Mucuna pruriens*, DC. Hind. '*Kawaj*.'

An annual of wide-twining habit. Short-peduncled drooping racemes 6" to 1' long, bearing 6-30 flowers. Corolla dark purple, 1.5" long; keel curved.

Flowering Season: October-November (Talbot).

Distribution: 'From Himalayas, in the plains, to Ceylon and Burma. Cosmopolitan in the tropics. Often cultivated' (Hooker).

Visitors: The Sunbirds *Leptocoma asiatica* and *L. zeylonica* regularly seen clinging upside down or sideways on to the flowers and probing into them with their bills. From the structure of the flowers, it appears very probable that these birds are instrumental in their cross-pollination and therefore in the propagation of this handsome-flowered, but pernicious, weed.

(Hooker gives 10 Indian species of the genus *Mucuna*, Adans. including perennials as well as annuals. They all have large showy, usually purple flowers which turn quite black when dry. The pods are covered with brittle needle-like irritating hairs.)

Order: MYRTALES

Family: LYTHRACEÆ

19. *Woodfordia fruticosa*, Kurz. Mahr. '*Dhaiti*.'

A shrub with long spreading branches, brilliantly red with flowers in the hot season. Flowers scarlet, tubular, about 1" long. The 'rim' (or lobes) is greatly reduced, offering no alighting place for insects. The flowers contain a good supply of colourless and odourless honey, and the essential organs are favourably placed for pollination by Sunbirds and Flowerpeckers.

Flowering Season: Hot weather, March to May.

Distribution : 'Throughout India, common; ascending to 5,000 ft. but not seen in the alluvial mud of Bengal, Baluchistan, Tropical Africa, Madagascar, China' (Hooker); also Japan, Sumatra and Java. In the Bombay Presidency, the plant is common on the Deccan hills and in the Konkan, Bombay, Poona; Khandesh, N. Kanara near the sea coast.

Visitors : I have noted the following species of birds probing into the flower-tubes for the nectar :

Leptocoma asiatica } Regular in the Kolaba District.
 „ *zeylonica* }

Leptocoma minima—(Partabgad Hill).

Æthopyga siparaja vigorsi—Frequently at Godbunder (Salsette).

Dicaeum crythrorhynchum—Frequently on the hillsides at Salao (Kolaba Dist).

For their visits the birds appear to prefer the morning hours upto about 11-30 A.M. when the sun is shining brightly upon the flower-laden shrubs. I have seen them, but less frequently in the afternoons also.

[Ball has recorded constant attendance on these flowers by *L. asiatica* in Chota Nagpur. (6, vol. ii, p. 397).]

Family : COMBRETACEÆ

20. *Calycopteris floribunda*, Lamk.

A dense and diffuse shrub with drooping branches, 6-12 feet high, often gregarious. Flowers sessile, yellowish-green in dense axillary racemes, crowded towards the ends of the branches so as to form large panicles. The small flowers—each with a lanceolate bract—are very like those of *Terminalia* and scarcely larger; they enlarge later into winged fruit. They are almost entirely devoid of smell and contain a quantity of clear honey. (Plate IV, 4).

Flowering Season : March-April.

Distribution : On hot hills 500-2,500 feet; abundant throughout the Deccan, and from Assam to Singapore.

Visitors : The following species have been commonly and regularly observed probing into the flowers, and doubtless assist in their cross-pollination :

Leptocoma asiatica
Leptocoma zeylonica
Prinia inornata

Family : MYRTACEÆ

21. *Careya arborea*, Roxb.

A tree attaining 30-60 feet. Flowers sessile, large white and pink, a few together crowded at ends of branches. They are of the ornithophilous type named by Werth the 'Brush Type.' (Plate IV, 3).

Flowering Season : March-April.

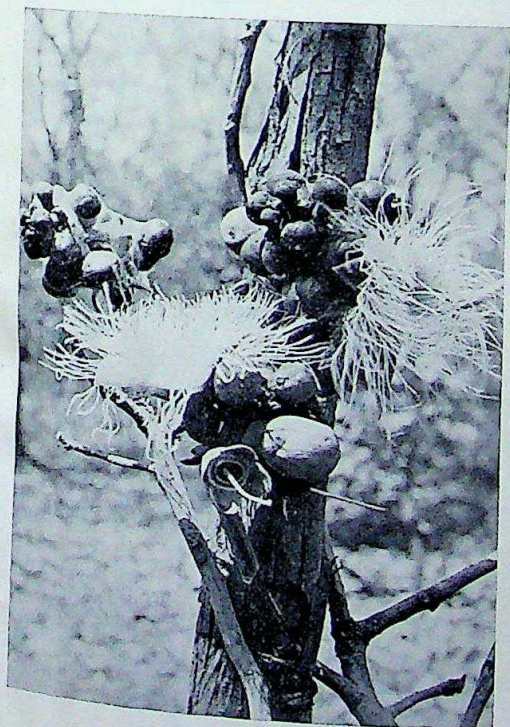
Distribution : Throughout India upto 4,000 feet: from the Himalayas to Travancore and Tennaserim. In Ceylon at moderate elevations,



1. *Leptocoma asiatica* on *Moringa oleifera*.



2. Flowers of *Sterculia colorata*.



3. Flowers of *Careya arborea*.



4. Flowers of *Calycopteris floribunda*.

Visitors: The following birds have been observed feeding regularly from the flowers :

Acridotheres tristis

Æthiopsar fuscus

Pastor roseus

Leptocoma asiatica

„ *zeylonica*.

[This tree belongs to a family which is large and well-represented in the Tropics. It contains many genera and species which are well known to be bird-pollinated. Among the species occurring in India and recorded as ornithophilous by Werth may be mentioned *Jambosa vulgaris* DC. (*Eugenia jambos*, Linn.) which, according to Brandis is indigenous in Sikkim and Terai, and *Barringtonia racemosa* (L.) common along the coasts in Konkan and elsewhere.

Among the best-known ornithophilous plants of this family however are the Eucalypti, of which numerous species have been introduced into this country. One of these, *Eucalyptus globulus*, Lab., which now flourishes on the Nilgiris has been recorded as being visited by Sunbirds in South Africa (Marloth) and by Humming-Birds in Chile (Johow), and although I have no definite information, there seems no reason why birds should not act as pollinators in the areas where it has become acclimatized in India also. According to Swynnerton (*Jour. Linn. Soc.*, London, Bot. 1906, p. 409) a *Pycnonotus* also visits the flowers of *Eucalyptus ficifolia* introduced into South Rhodesia (Porsch).

It is believed that the flowers of most of the moderate and large-flowered species of this genus are more or less exclusively ornithophilous in the Australian Region which is their home.]

Order : GENTIANALES

Family : ASCLEPIADACEÆ

22. *Calotropis procera*, Br.

A shrub 6-15 feet high. Corolla pale purple, $\frac{1}{2}$ "-2" in diam., of a wax-like structure, flowers in umbellate, axillary or terminal cymes. Corolla-tube broadly campanulate ; lobes $\frac{3}{4}$ the corolla.

Flowering Season : Throughout the year.

Distribution : 'Western and Central India ascending to 3,500 ft. from Sind and the Punjab to Bihar and Bombay. Ava, Persia, Tropical Africa.' (Hooker.) I have also seen it at Panchgani in the Western Ghats (4,400 ft.) near the top of Second Table-land.

Visitors : I have observed the Sunbirds, *Leptocoma asiatica* and *L. zeylonica* on the curious waxen purple flowers so regularly, and in so many different parts of the country (Sind, Hyderabad Deccan, the neighbourhood of Poona, Cambay (Gujerat), Bombay City and Salsette, and at various places in the Konkan) probing into the blossoms, that I cannot but consider it reasonable to suppose that they must often carry the pollinia adhering to the feathers of the forehead or throat to other flowers and promote cross-pollination.

As far as my observations go, the visits to the flowers are chiefly confined to the early morning or forenoon hours when the sun is shining directly upon the plant. I have often noted that a particular plant

has its own particular individual visitor (or visitors), and that this forms as it were his preserve from which other comers are jealously excluded. Thus at Panwel (Kolaba Dist.), a plant growing close to the Inspection Bungalow was the possession of a male *Leptocoma asiatica* in non-breeding attire whom I could recognize with certainty by certain peculiarities in his plumage. During the three or four days I occupied the bungalow, he alone visited the flowers of this *Calotropis* regularly, especially during the hours I have indicated above. While feeding, this Sunbird utters a double 'tweet-tweet' at intervals of a second or so, by which I was immediately apprised, in whatever part of the bungalow I happened to be, that my friend was on the flowers, and sure enough on every such occasion he was there! One morning on the bank of the river at Panwel, I found eight individuals of this species on a single *Calotropis* plant which was blossoming abundantly (30-1-31). They were hopping about merrily from flower to flower probing into them with their bills, and often clinging to the branches upside down in the quest. The plant grew in a thoroughly exposed situation, as is its habit, and when the birds were on it, it was exposed to the full blaze of the sun (10 o'clock).

In Sind, I have often found *L. asiatica brevirostris* on *Calotropis* flowers, at great distances in sandy wastes where there seemed little else to attract the birds.

Among insects *Xylocopa* is a regular attendant on the flowers. (*C. gigantea*, Br. will also no doubt be found to be visited by Sunbirds.)

Order PERSONALES.

Family: SCROPHULARIACEÆ.

23. *Russelia juncea*, Zucc.

A tender shrubby plant with smooth, somewhat rush-like leaves, noddy or pendulous at the top. The dazzling scarlet tubular flowers, about 1" in length, have the rims or lobes greatly reduced, are odourless and rich in nectar, and in all these respects appear eminently adapted for fertilization by Sunbirds.

Flowering Season: Practically throughout the year. (Kihim, October-November Panchgani, May-June.)

Distribution: A native of Mexico and Central America. A common ornamental garden plant everywhere in India.

Visitors: The flowers are a great attraction to Sunbirds, which visit them regularly in every garden. In Bombay City and North Konkan (Kolaba District) *Leptocoma asiatica* and *L. zeylonica* have been noted as the commonest visitors, and in Panchgani I have seen *L. minima* in addition to these.

Porsch quotes Motley (Shelley 'Monograph of the Nectariniidæ') who also constantly observed 3 or 4 *Cinnyris pectoralis* Bp. on a plant of this species outside his office window, hanging in all possible positions on the branches and probing into the scarlet tubular flowers.

In spite of these seemingly suitable bird-visits, the plant has to be propagated in this country entirely by layering and cuttings as for some obscure reason it never produces seed. This is one of the

many examples of introduced species which in spite of all apparent facilities for cross-pollination fail to produce seed in the country of their introduction.

Family : BIGNONIACEÆ.

24. *Millingtonia hortensis*, Linn. (Coloured Plate *J.B.N.H.S.*, vol. xxxiv, p. 85).

An erect tree upto 80 ft. high, lanceolate in outline, with drooping branches. The fragrant flowers grow in large panicles at the ends of the branchlets. Tiny bell-shaped calyx bears the slender tube-like flowers, 2"-3" long $\times \frac{1}{8}$ " , white with a faint green tinge. The tube expands into the waxy white petals, sometimes flushed with pink. The four petals are oval, pointed at the apex and the largest of them is deeply cleft. Four stamens crowned with yellow anthers. The style protrudes well beyond the anthers.

Flowering Season : In Bombay, the Konkau, Hyderabad (Deccan) flowering commences in October and continues till December. In other parts of India, August-September.

Distribution : Believed to be indigenous in the tropical forests of Burma, from Ava to Tenasserim and the Malay Peninsula. Cultivated in many parts of India, and runs wild in many areas such as the Godaveri Valley, Central India. Frequently planted along roadsides.

Visitors : The principal bird-visitors to the flowers noted in Konkau, Bombay and Hyderabad are the Sunbirds *Leptocoma asiatica* and *L. zeylonica* which cling to the branchlets and probe methodically into the corolla-tubes for the nectar.

In the evergreen forests of Tenasserim (on the hills surrounding the Mining Company's dam at Kanbauk), I also observed a great many Sunbirds probing into the flower-tubes. Owing to the height of the trees and absence of binoculars, I was unfortunately unable to determine the species.

Curiously enough, the tree does not produce fruit in Western India or the Central Provinces.

(Since this paper went to press, I have had better opportunities of observing the activities of the Sunbirds *Leptocoma asiatica* and *L. zeylonica* on the flowers of this tree. I find that while it is true that the birds occasionally probe into the tubes in the manner conducive to cross-pollination, by far the more usual method adopted by them is to get at the honey by boring short-cut holes with their bills at the base of the corolla-tube just above the calyx.)

25. *Spathodea campanulata*, Beauv. (Coloured Plate *J.B.N.H.S.*, vol. xxxiv, p. 716.)

Handsome, erect evergreen trees (except in the drier areas where leaves are shed for a few weeks) growing to 70 feet, with large pinnate leaves and very showy scarlet, bell-shaped flowers, mostly near the top. From its curving boat-shaped calyx, the flower emerges as a short tube which abruptly expands into a wide bell some 4" long. Lobes of flower oval and wavy-margined. Flower, orange at base deepening into brilliant crimson further up. Inside rich yellow, streaked with red. Four yellow exserted stamens tipped

with pendant brown anthers. The nectary glands exude a profusion of nectar.

Flowering Season : In Bombay chiefly January-March, but also in the rains. In Ceylon throughout the wet season.

Distribution : A native of tropical Africa. Introduced into Ceylon in 1873. Grown in gardens in India and planted as a roadside tree along many of Bombay's thoroughfares, Lamington Road, Chowpati and elsewhere.

Visitors : The conspicuous large scarlet flowers attract many species of birds who may be seen probing into the 'bells' to get at the abundant nectar at all hours of the day, but specially from the early morning uptil 11-30 or so. Within City limits the birds usually seen 'on duty' are *Corvus splendens*, *Acridotheres tristis* and the Sunbirds *Leptocoma zeylonica* and *L. asiatica*. On a magnificent specimen flowering in the garden of Khan Bahadur Bhivandiwalla at Uran (Kolaba Dist.) in January, I watched a company of birds feeding from these flowers through binoculars for a considerable time. In addition to the species already mentioned, there were in this assemblage *Corvus macrorhynchus*, *Æthiopsar fuscus*, *Molpastes cafer* and *Elathea jocosa*.

Through what agency the flowers are pollinated in their native country I do not know, but it is clear that in India birds play an important part in their fertilization.

My doubts as to whether this tree produced fertile seed in India were dispelled by Mr. D. S. Laud, the Superintendent of the Victoria Gardens, Bombay, who informs me that the roadside trees in Bombay seed freely. These seeds are used for the propagation of plants on sale at the Gardens and show a high percentage of germination. At the Empress Gardens, Poona, also they collect their own *Spathodea* seeds for propagation purposes. In the face of this it is interesting to learn from the Curator, Government Botanical Gardens, Ootacamund, that this tree produces only a very few fertile seeds at Burliar—at an elevation of 2,500 feet in the Nilgiris—probably not more than 1 per cent.

[In the Buitenzorg Gardens in Java, Porsch (12) observed *Sturnopastor jalla* Horsf. and *Pycnonotus aurigaster* Vieill. quenching their thirst from the nectar of *Spathodea campanulata* flowers.]

Family : ACANTHACEÆ.

26. *Adhatoda vasica*, Nees.

Usually a dense shrub, 4-8 ft. high, sometimes arborescent and reaching to 20 feet. Flowers white in dense axillary, peduncled spikes near the ends of the branches. Corolla 1.25" long; tube .5" long, lower part cylindrical, inflated above. Filaments long, curved.

Flowering Season : Kolaba District, January.

Distribution : 'India from the Punjab and Assam to Ceylon and Singapore, common, frequently cultivated. Malaya and S.-E. Asia' (Hooker). A common hedge-plant throughout the Bombay Presidency from Gujerat to North Kanara.

Visitors : I first observed the Sunbird *Leptocoma zeylonica* on some shrubs forming a roadside hedge in a village near Mahad (Kolaba District). Numbers of these birds were in constant attendance on the

flowers. Subsequently in other parts of the district, both this species and *L. asiatica* were invariably seen feeding on nectar from the flowers. There is usually great rivalry between the two species, and even between individuals of the same species and many mock-battles and sorties ensue.

Order : LAMIALES.

Family : VERBENACEÆ.

27. *Gmelina arborea*, Linn.

An unarmed tree, sometimes attaining 60 ft., deciduous, flowering with young leaves. Corolla brown-yellow; upper lip shortly bifid, longer than lower. The rim of the flower is greatly reduced, and the position of the essential organs seems well adapted for bird-pollination.

Flowering Season : March—April.

Distribution : 'Throughout the Deccan Peninsula and Ceylon, frequently extending to the foot of the N.-W. Himalayas, Chittagong, Malayan and Philippine Islands' (Hooker).

Visitors : On a tree flowering in the middle of March at Kihim (Kolaba District), the Sunbirds *Leptocoma asiatica* and *L. zeylonica* were constantly observed hopping from branch to branch, probing into the tubular nectar-bearing flowers throughout the day.

28. *Duranta Plumieri*, Jacq.

Familiar ornamental shrubs planted in gardens and as hedges. Bright heliotrope-coloured flowers in drooping bunches, succeeded by orange-coloured berries of the size of a pea.

Flowering Season : Chiefly during the rains, simultaneously with the appearance of the new leaves on the bare branches, or soon after.

Distribution : A native of South America. Found in gardens all over India and planted as roadside hedges.

Visitors : In the Kolaba District and in Bombay City and suburbs *Leptocoma asiatica* and *L. zeylonica* have been observed as constant visitors to the flowers, probing with their bills into the tubes for nectar. In Panchgani *Leptocoma minima* has been noted as a regular attendant besides. The corolla-tubes are short and the stamens and style not sufficiently exerted to permit of their coming into contact with the forehead feathers. If the birds are instrumental in cross-pollination, which I consider more than probable, the pollen must be transported adhering to their bills of which not more than $\frac{1}{3}$ can be inserted into the flower.

The pollen grains of *Duranta* under a microscope appear thus : Fig. 3.

Besides the Sunbirds, a number of insects have been noted on the flowers, principally *Xylocopa (amethystina?)* and bees (spp.?)

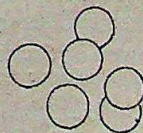


FIG. 3.

Order: CURVEMBRYAE.

Family NYCTAGINACEÆ.

29. *Bougainvillea spectabilis*, Willd.

A large, thorny, extensively climbing shrub. Flowers in profusion, small pale yellow supported by large purple or magenta-coloured bracts, in groups of three.

Flowering Season: Hot weather.

Distribution: A native of Brazil. Found in gardens all over India.

Visitors: The flowers are in regular and constant attendance by Sunbirds of which I have noted (according to locality), the following species carefully through glasses, probing with their bills deep into the flower-tubes and sipping the nectar:

Leptocoma asiatica

„ *zeylonica*

„ *minima*

Æthopyga siparaja vigorsi

Although the flowers appear in every way suitable for pollination by Sunbirds, this climber also fails to produce seeds in this country. What appears surprising is that *Bougainvillea laterita*, bearing brick-red bracts, which is sometimes considered only a variety of *spectabilis*, is reported by the Superintendent, Victoria Gardens, Bombay, to produce seed.

Order: ACHLAMYDOSPOREAE.

Family: LORANTHACEÆ.

• (Tree Parasites.)

(The genus *Loranthus* contains, according to Hooker, altogether some 350 species exclusively tropical and sub-tropical. He gives 58 species as occurring within Indian limits, besides 13 doubtful and excluded. The flowers are classified by Werth (21) into the ornithophilous type which he names 'Explosive Flowers,' and to which many of the African *Loranthi* also belong.)

30. *Loranthus longiflorus*, Desr. Var. *falcata*. Kurz.

Corolla tubular, 1"-2" long, pink or yellowish-white.

Flowering Season: Throughout the year, most abundantly in the cold weather.

Distribution: Deccan Peninsula, Ceylon.

31. *Loranthus langeniferus*, Wight.

Corolla 1.5" long, tube dilated upwards, red below, green above, anthers reddish; style red.

Flowering Season: April, May, June. (Talbot) September (Kihim!).

Distribution: Hills of the Konkan.

32. *Loranthus loniceroides*, Linn.

Corolla 1-1.5" long; tube funnel-shaped, pink; anthers orange.

Flowering Season: February to May (Talbot); June, July (Panchgani!).

Distribution: From the Konkan to Travancore, W. Ghats, Nilgiris, Ceylon.

33. *Loranthus scurrula*, L. var. *cordifolia*, Blatt.

Corolla greenish-yellow, about .5" long; filaments flattened, crimson.

Flowering Season : November-February (Talbot) ; June, July (Panchgani !)

Distribution : Common throughout India, Ceylon, Malaya. Variety found in the W. Ghats.

34. *Loranthus obtusatus*, Wall.

Corolla red outside, dark purple within.

Flowering Season : March to May and September.

Distribution : Konkan, W. Ghats, N. Kanara.

35. *Loranthus cuneatus*, Heyne.

Corolla tube slender, upto 1" long : greenish yellow outside, orange within. Stigma red. Leaves small and ovate closely resembling those of *Osiris arborea*, in appearance.

Flowering Season : November-December (Talbot) ; June, July, August (Pauchgani).

Distribution : W. Peninsula, Ceylon.

I have shown elsewhere¹ how admirably adapted the flowers of *Loranthus longiflorus*, Desr. are for fertilization by the *Nectariniidae* and the *Dicaeidae*. Their structure is such that the mature buds wither and fall away without opening, unless and until external pressure is exerted on their tips by the bills of the visitors which alone can cause them to fling open. No insect can get at the nectar contained in the corolla-tubes until the buds are opened. The shape and size of the flower constitutes a perfect sheath for the bill of the Sunbird, and the style which overtops the stamens is so placed that it cannot but brush against the forehead of the probing visitor. In the act of nectar-eating, the anthers carrying the ripe pollen lie flat against the forehead feathers of the visiting bird thus smearing them with a liberal coating of the golden dust which is subsequently transferred to the protruding stigma of the next flower visited. All the *Loranthus* species above named possess the same spring or 'explosive' mechanism in their buds, and consequently the agency of the birds is indispensable for their pollination. Without their intervention, it is obvious that the parasites would soon die out completely.

I believe it is the conspicuous yellowish, reddish or coppery tinge of the *Loranthus* leaves which plays the role of poster-signs, making the clumps of the parasite stand out clearly from amidst the surrounding foliage of the host, and thus helping to attract the attention of foraging birds from a distance.

Visitors : The birds responsible for the fertilization of *Loranthus* flowers in the Konkan are :

Leptocoma asiatica *

" *zeylonica* *

" *lotenia* *

Dicaeum erythrorhynchum *

Aethopyga siparaja vigorsi (in wooded country).

¹ J. B. N. H. S., vol. xxxv, p. 145.

Eisewhere on the Ghats, Mahableshwar, Panchgani, etc., I have in addition noted *Leptocoma minima* as a very common and regular visitor to the flowers, and a White-eye (*Zosterops palpebrosa*) shot off a clump of *Loranthus scurrula* in the act of springing the buds open and probing for nectar, was found to have some of the characteristic winged pollen grains adhering to its forehead feathers.

The only bird outside the typical nectar-eating families observed on *Loranthus* flowers (*scurrula*) is *Molpastes cafer*, several pairs of which I have often watched through binoculars for prolonged periods, hopping from one cluster to another parasiting on a *Ficus retusa* at Panchgani, busily engaged in nipping the mature buds open and probing into the corolla tubes for nectar. The tube in the species named is slender but is slit down for more than half its length, thus enabling the somewhat heavy bill of the bulbul to reach the honey. On one or two of the birds there was clearly visible a whitish streak running from the base of the bill over the forehead towards the crown where the pollen was adhering. There was a Flowerpecker feeding on another *Loranthus scurrula* clump on the same tree, and I noticed that whenever he flitted across to the clump occupied by the bulbuls, the latter immediately assailed him and drove him off.

A very remarkable case frequently quoted to show the correlation between the geographical distribution of ornithophilous flowers and of their particular pollinating agents, and the complete interdependence between the two, is that of the Sunbird *Cinnyris osea* and *Loranthus acaciæ* Zucc. in Palestine. It is significant that the northern distributional boundary of the *Nectariniidæ* (extending from Senegambia to Kordofan, Nubia, Abyssinia, Palestine, Baluchistan, Nepal, Sikkim, Siam, Cochinchina and up to the Philippines) corresponds more or less exactly with the northern limits of the best known ornithophilous plants such as *Musa*, *Loranthus*, *Hibiscus* (?), *Bombax*, *Erythrina*, *Kigelia* and perhaps also *Rhododendron*. The only region in Asia above this line i.e. above 30° N.Lat., where a member of the *Nectariniidæ* occurs is Palestine. *Cinnyris osea*, the species in question, is found as far north as the Genazareth Sea and perhaps farther. Its principal distributional area however is in the neighbourhood of the Dead Sea, where strangely enough is also found, transgressing its usual bounds, a species of *Loranthus*, *L. acaciæ*, Zucc. The distribution of this plant as given by G. E. Post (*Flora of Syria, Palestine and Sinai*, 1896), overlaps completely that of *Cinnyris osea* and shows the symbiotic relationship between the flower and the bird.

[According to Engler (Engler-Prantels Nat. Pflanzenfam. iii, 1, p. 184) *Loranthus acaciæ*, Zucc. is found in Nubia, Palestine and Abyssinia. It also occurs in Arabia (Hadramaut). Reichenow gives the distribution of *Cinnyris osea* (Die Vogel, Handb. d. system. Ornithologie, ii, 1914, p. 487) as Syria, Palestine and Arabia. Porsch (14, pt. i, p. 234) states that in Palestine it is the only Sunbird and ensures the pollination of the *Loranthus*. Hart (4) also remarks on the occurrence together of *Loranthus acaciæ* Zucc. and *Cinnyris osea* in the Sinai Peninsula, where the former parasites on tamarisk and *Zizyphus*. He procured specimens of this Sunbird and found their long bills covered with pollen of the tubular flowers for probing which they are well adapted, and surmises that the plant is dependent

for the fertilization of its flowers on the visits of this species. Over other portions of the range of *Loranthus acaciae* various other *Cinnyris* spp. also act as pollinators].

Clear-cut instances of this kind of symbiosis between Humming-birds and the bird-flowers they chiefly frequent are well known, and it has likewise been pointed out that the disappearance of the Honey-eaters *Anthornis melanura* and *Prosthemadera nova-zealandiae* in the Auckland Islands (south of New Zealand) at the southernmost extremity of tree-growth, would spell the speedy extinction of *Metrosideros lucida* and *Dracophyllum longifolium* whose flowers are dependent for their fertilization exclusively on these species.

I feel confident that intensive study of the subject in India will lead to much interesting knowledge concerning the connection between flower-birds and the geographical distribution of bird-flowers. *Loranthus* flowers with their bird-operated explosive mechanism and their undoubted ornithophilous character might well afford a suitable starting point for such an investigation.

Another interesting investigation which the subject of Ornithophily opens up, and on which little or no work has been so far done in India, is as regards the shape and structure of pollen grains. It is likely that a careful study may reveal special adaptations for ensuring the adherence of the pollen of highly organised ornithophilous flowers to the feathers of their bird-visitors. Thus, according to Stresemann (17, p. 451), the pollen grains of *Phrygilanthus* and other ornithophilous *Loranthi* in Santiago are equipped with tiny wing-like processes which make it easier for them to cling between the barbules of the bird-feather than it would be for round-shaped grains.

I have examined the pollen grains of *Loranthus longiflorus*, *L. scurrula* and *L. cuneatus* microscopically and find this peculiarity to hold good in the case of these Indian species also. A diagram of their structure is given here. (Fig. 4.) In all three species they are identical in shape but in *cuneatus* they are about one-third larger than in the other two. The shape of the pollen grains has obviously a direct connection with the fact that all the three species are highly adapted bird-flowers. I found the pollen grains of *L. longiflorus* to be indistinguishable from those of *L. scurrula*.

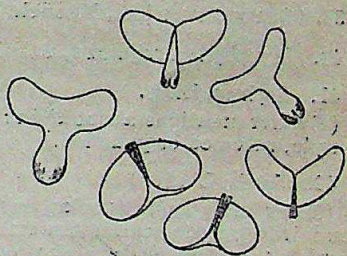


FIG. 4.

MONOCOTYLEDONES.

Order : CALYCINÆ.

Family : PALMÆ.

36. *Cocos nucifera*, Linn. The Coconut Palm.

Flowers unisexual, male and female on the same spadix.

Flowering Season : Practically throughout the year.

Distribution : 'Cultivated in the hot damp regions of India, Burma and Ceylon, especially near the sea; (indigenous in the Cocos Islands and North Andamans, Kurz). All tropical shores' (Hooker).

Visitors : I have time and again observed both *Leptocoma asiatica* and *L. zeylonica* on the spadices of the flowers at most hours of the day. At Kihim in December, two or three birds of the latter species were watched on the same tree day after day early in the mornings, just before sunrise, when the dew was yet so heavy that it dripped from the leaves. That they were taking off the dew from the blossoms I have no doubt, but whether they were instrumental in transferring the pollen to the female flowers, it was not possible to ascertain. Hume, Davidson and so many other observers in India have repeatedly recorded these and other species of Sunbirds attending on the coconut inflorescence, and it would be interesting to discover the true significance of these visits.

Little is known about the pollination agencies of this palm, though insects are believed to operate, and Hermann Müller (7, p. 562) on the authority of Delpino also states that the flowers of *Cocos* are anemophilous.)

The following is a list of some of the more familiar genera and species of plants occurring in this country as indigenous or well-established exotic species whose flowers have been referred to as entirely, or in part, ornithophilous in the literature I have consulted on the subject.

37. *Celba pentandra*, Gaertn. (= *Eriodendron anfractuosum*, DC.)

38. *Bruguiera gymnorhiza*, Lamk.

(I have often casually seen *Dicæum erythrorhynchum* among the branches of this mangrove in the tidal swamp at Rewas (Kolaba Dist.) but not noticed it feeding from the flowers.)

39. *Quamoclit coccinea*, Moench (= *Ipomæa coccinea*, Linn.)

40. *Bryophyllum calycinum*, Salisb.

41. *Sophora*, Linn.

(Hooker mentions about 10 Indian species. Flowers showy yellow or violet-purple, racemed or paniced.)

42. *Salvia*, Linn.

(Many indigenous species, mostly Himalayan. I have frequently noticed Sunbirds on the scarlet flowers of *Salvia splendens*, a familiar introduced garden plant which has been recorded by W. Trelease (Amer. Natur. vol. xv, pp. 265-69, 1881. Bot. Centralbl. No. 50, 1881), as Humming-bird-fertilized.

43. *Lonicera*, Linn.

(Many species in India).

44. *Leonotis nepetæfolia*, Br.

45. *Lobelia*, Linn.

(Many indigenous species).

46. *Canna indica*, Linn.

(Sunbirds commonly seen on flowers).

47. *Musa*.

(Hooker gives three species: *paradisiaca*, Linn., *textilis*, Nee., and *sapientum*, Linn.)

48. *Amherstia nobilis*, Wall.

49. *Vitex pubescens*, Vahl.
50. *Lumnitzera coccinea*, Wgt. et Arnott.
51. *Sonneratia acida*, L. f.
52. *Gloriosa superba*, Linn.
53. *Grevillea robusta*, A. Cunn.
54. *Eucalyptus globulus*, Lab. and many others of this genus.

LIST OF BIRDS OBSERVED TO BE REGULAR FLOWER-FREQUENTERS¹

Order : Passeres

Family : CORVIDÆ

1. *Corvus macrorhynchus* Lesson, 1*, 2, 8*, 9, 11*, 25.
2. „ *splendens* Vieill, 1*, 2, 8*, 11*, 17, 25.
3. *Dendrocitta rufa* Latham, 1, 2, 8.
4. *Crypsirina temia* Daudin. (Observed by E. Henricks on red flowers of cotton tree in Henzada Dist., Burma, *Bombax malabaricum* ?)

Family : TIMALIIDÆ

5. *Turdoides terricolor* Hodgs 8.
6. „ *somervillei* Sykes, 1, 2, 8*, 9, 11.
7. *Xiphorhamphus superciliaris* Blyth. (Meinertzhagen, Ibis 1927, p. 575, notes that near Darjeeling, a pair used to visit a red cotton tree in bloom and studiously probe the flowers.)
8. *Dumetia albogularis* Blyth, 1, 2, 8*.
9. *Chrysomma sinensis* Gmelin, 1, 2, 8*.

Sub-Family : LEIOTHRICINÆ

10. *Ægithina tiphia* Linn., 8, 16.
 11. *Chloropsis aurifrons* Temm. and Laug. 8*.
 12. *Chloropsis jerdoni* Blyth, 8*, 9.
- (As noted by Porsch, *Chloropsis* has a feathery tip to its tongue. The tongue is bifurcated at the tip into two sets of bristles which roll over each other to form a tube. The entire length of the organ, moreover, is concave on the upper side forming a channel. Observation and study is necessary to determine the significance of this.)

Family : PYCNONOTIDÆ

13. *Microscelis psaroides ganeesa* Sykes (Noted by Betts, J.B.N.H.S., vol. xxxiv, p. 1027, on *Erythrina* flowers).
14. *Molpastes cafer* Linn. 1*, 2, 8*, 9, 17, 25, 33.
15. *Elathea jocosa* Linn. 1*, 2, 8*, 9, 17, 25.
16. *Pycnonotus luteolus* Lesson, 1, 2, 8*.

Family : TURDIDÆ

Sub-family : PHENICURINÆ

17. *Copsychus saularis* Linn. 8*.

Sub-family : TURDINÆ

18. *Turdus merula nigropileus* Lafresnaye 1*, 2, 8, 9*.

Family : MUSCICAPIDÆ

19. *Muscicapula tickelliae* Blyth, 8.
20. *Tchitrea paradisi* Linn. 8.
21. *Hypothymis azurea* Boddaert, 8.
22. *Leucocirca pectoralis* Jerdon, 8.

Family : LANIIDÆ

23. *Lanius schach erythronotus* Vigors, 8

Family : DICURIDÆ

24. *Dicurus macrocercus* Vieillot, 1, 2, 8*, 9.
25. „ *cærulescens* Linn. 1, 2.

Family : SYLVIIDÆ

26. *Orthotomus sutorius* Pennant, 1*, 2, 8*, 9.
27. *Prinia socialis* Sykes, 1, 2, 8.
28. „ *inornata* Sykes, 8, 20.

¹ Numbers after species refer to foregoing list of plants.

Family : ORIOLIDÆ

29. *Oriolus oriolus kundoo* Sykes, 1, 2, 8.30. " *xanthornus* Linn. 1, 2, 8.

Family : STURNIDÆ

31. *Pastor roseus* Linn. 1*, 2, 8*, 21.32. *Sturnia malabarica* Gmelin, 1*, 2, 8*, 11.33. *Temenuchus pagodarum* Gmelin, 1, 2, 8*.34. *Acridotheres tristis* Linn. 1*, 2, 8*, 9, 11*, 17, 21, 25.35. *Æthiopsar fuscus* Wagler 1*, 2, 8*, 11, 21, 25.

Family : PLOCEIDÆ

36. *Ploceus philippinus* Linn. 1, 2, 8*.37. *Uroloncha malabarica* Linn. 8.38. " *striata* Linn. 8.

Family : FRINGILLIDÆ

Sub-family : FRINGILLINÆ

39. *Carpodacus erythrurus roseatus* Blyth, 6, 8*.40. *Gymnoris xanthocollis* Burton, 1, 2, 8.41. *Passer domesticus* Linn. 1, 2, 8.

Family : ZOSTEROPIDÆ

42. *Zosterops palpebrosa* Temm. and Schlegel, 1, 2, 6, 8, 33*.

Family : NECTARINIIDÆ

Sub-family : NECTARINIINÆ

43. *Æthopyga siparaja vigorsi* Sykes, 1, 2, 3, 8, 19, 29.44. *Leptocoma tolenia* Linn. 1, 2, 3, 8*, 9, 30*, 31.45. " *asiatica* Latham, 1, 2, 3, 4, 5, 6, 7, 8*, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30*, 31, 32, 33, 34, 35, 36, 42.46. " *minima* Sykes, 3, 19, 23, 28, 29, 30, 31, 32, 33, 34, 35, 42.47. " *zeylonica* Linn. 1*, 2, 3, 4, 5, 7, 8*, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30*, 31, 32, 33, 34, 35, 36, 42.

(The above family is represented in India by 5 genera and 23 species with numerous sub-species. They are distributed in almost every part of India, Burma and Ceylon, and are the most important pollinators of flowers among the birds.)

Family : DICAËIDÆ

48. *Dicaeum erythrorhynchum* Latham, 5, 16, 19, 30*, 31, 32, 33, 34, 35.

Order : Coraciiformes

Sub-Order : PICI

Family : PICIDÆ

49. *Brachypternus benghalensis* Linn. 8.

Sub-Order : CUCULI

Family : CUCULIDÆ

Sub-family : EUDYNAMINÆ

50. *Eudynamis scolopaceus* Linn. 8.

Sub-Order : PSITTACI

Family : PSITTACIDÆ

51. *Psittacula krameri* Scop, 1, 2, 8*, 13, 17.52. *Coryllis vernalis* Sparrman, 8.

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MEASUREMENTS AND NOTES ON SOME LITTLE-KNOWN
CEYLON MAMMALS.

Collected at West Haputale, Ohiya. (Altitude 6,000 feet.)

BY

A. C. TUTEIN-NOLTHENIUS, F.Z.S.

(With 1 text-figure).

The following notes have been made while collecting small mammals for Scientific purposes, in the country and jungles adjoining West Haputale estate.

The estate lies hidden in one of the deep valleys on the southern face of the mountain range, some 1,000 feet below the Horton Plains, and so far very little collecting of small mammals had been done.

The altitudes proper run from 4,000 feet to 6,000 feet and higher. The average rainfall is about 110 inches, October to December being the wettest months during the North-East monsoon. The S.-W. is dry and very windy.

The jungles surrounding the north and east sides of the estate are for the most part high and heavy virgin forest with its usual vegetation. Lower down the patnas border the estate, while in the ravines and along the boundaries much *Paspalum* grass is grown.

Nearly all trapping was done round and near the main bungalow, situated at an elevation of 6,000 feet. Coconut was mostly used as bait, while various shrews were trapped by using meat.

I have to thank Mr. W. W. A. Phillips, for having initiated me in this very interesting study, and for all the help and advice he has so freely given me, reading my notes and identifying specimen collected.

GENUS: RATTUS.

Rattus ohiensis. Phillips.

The Ceylon Bi-coloured Rat.

Collected and described by W. W. A. Phillips, F.Z.S., in the *Ceylon Journal of Science*, section B., vol. xv, part ii, p. 167.

Type.—An adult male, caught on December 1 1928, at West Haputale, Ohiya, in the province of Uva, Ceylon.

The type is in the British Museum.

Measurements of the type are—

Length of head and body	...	150 mm.
Length of the tail	...	187 "
Hind foot	...	33 "
Ear	...	22 "

Description.—This very pretty animal is about the same size as the common house rat but it is more slender in shape and much finer looking. The face is long and pointed, the tail much longer than the head and body. Ears are large and naked.

Fur short, very soft, rather woolly on the underparts. Feet are covered with very fine fairly stiff hairs, small tufts of stiff hairs above the whitish claws. Whiskers are numerous and very long. Tail scaly and covered with minute hairs.

Colour.—Upper parts of the head and all over the back, darkish slate grey to black or blueish black. Underparts pure snow white, with a very sharp dividing line where the darker fur meets the white, starting on the lower jaw and running down to the root of the tail. The snout is light blue-grey and sometimes slightly pinkish. Whiskers black, intermixed with silvery ones.

NOTES ON SOME LITTLE-KNOWN CEYLON MAMMALS 607

Most noticeable is the coloration of the tail in all specimen. It is truly bi-coloured, the exact upper half over the entire length of the tail, being darkish dull black, the under half being pure white.

The type specimen showed only some pure white at the extreme tip of the tail, but since then several specimen have been collected with a pure white end to the tail, measuring from 25 to 30 mm. in length. I had an idea this might be a sign of age, but most of those specimen, examined by Phillips, proved to be adults.

Habits.—At the time Phillips collected the first single specimen, now known as the Type, it was thought that the species which had never been seen before in this neighbourhood, was uncommon, but later experience has proved that it is by no means rare round here, between elevations of 5,000 to 6,000 feet. Below 5,000 feet no specimen so far has been collected. Sometimes three or four were brought in on one day, all trapped with coconut, near or in the jungle surrounding the bungalow and gardens, a few were trapped between the tea bushes, while one (No. 50) was caught actually in the bungalow.

Sexual differences.—Appear to be very slight, but the female averages slightly smaller in size.

Identification.—This rat is very easily identified by the very noticeable, typically bi-coloured tail, and the pure white underparts.

Parasites.—A few minute red ticks and very rarely a flea.

Feeding.—Stomach contents so far have only shown vegetable matter.

Remarks.—Nothing as yet is known about its breeding habits; several males in 'rut' have been collected but none of the seven females appeared to be pregnant. All specimen given in my list were collected during May and July.

Phillips remarks that it would appear that this rat is allied to *Rattus niviventer*, the White-bellied Rat of the Himalayas.

The species being new, I give a complete list of all the different measurements.

Measurements:

Coll. Number.	Head and body.	Tail.	Hind foot.	Ear.	Sex.
28	161	182	33	22	♂
29	146	180	34	23	♀
34	142	185	33	22	♂
37	146	170	31	20	♂
38	161	177	34	21	♂
41	166	173	30	21	♂
42	140	170	31	21	♂
44	142	166	32	19	♂
45	149	178	32	21	♂
47	167	193	34	21	♂
50	165	178	33	23	♂
57	125	148	28	19	♂
77	134	160	31	20	♂
82	167	196	35	22	♂
108	162	187	33	22	♂
109	149	170	33	21	♂
114	154	186	32	22	♂
116	140	185	34	21	♂
121	175	191	33	21	♂
122	161	190	35	22	♂
124	137	162	30	21	♂
125	140	173	30	20	♂
127	161	188	34	20	♂
129	163	192	32	22	♂
136	155	180	33	20	♂
137	140	168	31	20	♂
140	146	180	32	20	♂
141	141	172	31	19	♂

Coll. Number.	Head and body.	Tail.	Hind foot.	Ear.	Sex.
142	140	180	31	19	
143	143	184	32	20	♂
145	140	172	31	20	♂
146	138	162	30	19	♂
154	125	163	32	20	♂
159	141	189	32	20	♂
166	143	178	31	21	♀
167	155	185	31	20	♀
174	144	191	32	21	♂
178	180	191	32	23	♂
186	167	192	33	22	♂
187	148	173	32	22	♀
Average 33 males	150.39	179.87	32.24	20.72	
Average 7 females	145.57	170.00	31.28	21.28	

GENUS: RATTUS.

*Rattus rattus kelaarti**The Ceylon Highland or Kelaart's Rat; The Common Rat.*

Rattus rattus kelaarti. Phillips. *Ceylon Journal of Science*, Sect. B., vol. xiv, part ii, p. 264.

I do not propose to describe in detail this common Ceylon up-country rat, so well known to, and so very much disliked by every one who has had to spend some time of his life in an up-country bungalow.

The damage this small, prolific rodent does, is well-known and truly amazing. I have known it gnawing wooden picture frames hanging against the wall, and silver mustard pots having been scratched by the sharp little teeth.

It seems to have a great liking for flowers left overnight in a room, specially carnations which it tears into tiny little bits and leaving them all over the place.

One particular old female here made it a habit to decorate her nest with small objects which it carried or dragged every night from the mantelpiece, going so far as to take away and use a box of gramophone needles, a "mushroomed" rifle bullet, and a small ivory tortoise.

Phillips gives the average measurements for 9 males, as—

length of head and body	...	157.5 mm.
length of tail	...	170.5 "
hind foot	...	31 "
ear	...	20 "

and the average measurements for 5 females, as—

length of head and body	...	149 mm.
length of tail	...	176.4 "
hind foot	...	30.4 "
ear	...	20 "

The average measurements of specimen collected here, are—

	head and body	tail	hind foot	ear
31 males	...	145.70	168.00	30.09
25 females	...	149.20	180.64	30.40
				19.77
				19.84

Parasites.—Several large fleas have been collected off these Kelaart's rats and will be examined and identified, as it is thought that some of these parasites are peculiar to up-country districts.

NOTES ON SOME LITTLE-KNOWN CEYLON MAMMALS 609

GENUS : CŒLOMYS.

Coelomys mayori. Thomas.*Mayor's Spiny Rat*.

1915. *Cœlomys mayori*. Thomas. *Journal B. N. H. Society*, vol. xxiii, p. 416.

The genus is peculiar to Ceylon. W.W.A. Phillips, *Ceylon Journal of Science*, section B, vol. xiv, part 2, p. 275.

Type Locality.—Pattipola, Central Province, Ceylon. (Elevation 6,000 feet, about 10 miles from here. a.c.t-n.)

Specimen of this small jungle rat were collected for the first time by Major W. E. Mayor, in 1915, at Pattipola, Ohiya, and on the Horton Plains, elevations from 5,700 feet to 7,000 feet. It appears to be fairly common in the jungles round here.

Phillips gives the measurements of one male, as—

length of head and body	...	102 mm.
length of tail	...	100 "
hind foot	...	25 "
ear	...	12 "

My averages for 20 males, give a hindfoot measurement of 23.30 mm., and a fair measurement for identification is 23 mm. for the hindfoot, twenty-five out of thirty-two specimen measured show an exact 23 mm.

Identification.—The small size, half the size of a common Ceylon rat, the very rough, harsh and spiny fur (hence its name of Spiny rat), and the hindfoot measurement of 23 mm.

Fur.—Upper hairs or fur, distinctly rough and hard, numerous stiff and longer 'spines' interplanted, underfur very soft and short wool. Fur on underparts softer and short. Minute hairs on the feet. Tail scaly with minute hairs. Whiskers numerous and fairly long. Ears naked.

Colour.—General colour of upper parts darkish, reddish brown to black, the spiny hairs sometimes silvery grey, more often quite black. The softer fur tipped reddish brown, giving a somewhat 'speckled' appearance to this little animal. Feet grey, tail dusky with slightly lighter coloured underside. Ears dusky to black. Underparts brownish grey.

There are said to be only two species of *Coelomys* in Ceylon, *Coelomys mayori*, and *Coelomys bicolor*, as the name of the latter implies, of a distinct coloration, the underparts being pure white.

C. bicolor, so far has been found only up to an elevation of some 3,000 feet, while *C. mayori* is confined to the higher altitudes, but just lately a specimen was collected here with distinctly pure white underparts; most unfortunately it (No. 54), could not be preserved.

In practically every specimen collected, the ears were covered with several, small or quite large, warts of a dirty greyish colour.

Habits.—This small rat seems to be fond of living in high, damp jungle, generally prowling about near the trunks or stumps of large or dead trees, or near and under boulders and rocks where the vegetation is rank and damp. All, so far, have been trapped with coconut, while stomach contents showed tiny seeds and vegetable matter.

Parasites.—Every specimen swarms with numerous minute red or grey ticks.

Sexual differences.—None noted, probably the female is slightly smaller in build. No outward signs of "rut" were noted in any of the males taken.

Measurements:

Coll. Number.	Head and body.	Tail.	Hind foot.	Ear.	Sex.	
2	90	92	23	17	♀	
3	80	90	23	18		♀
10	100	90	23	18	♀	
18	107	101	23	17		♀
19	85	85	23	15	♀	

Coll. Number.	Head and body.	Tail.	Hind foot.	Ear.	Sex.
20	100	82	23	17	♂
22	93	94	23	16	♀
23	80	72	22	12	♀
35	102	101	22	17	♀
43	100	85	23	18	♂
46	88	93	23	17	♂
49	87	112	25	18	♂
53	96	100	23	17	♂
54	99	89	23	18	♀
55	110	100	23	19	♂
56	95	90	23	14	♂
60	101	99	23	16	♀
62	97	85	23	15	♂
63	105	99	24	17	♂
81	92	93	23	16	♂
94	103	104	24	16	♂
123	116	98	24	17	♂
126	105	88	23	18	♀
139	103	96	23	16	♂
152	101	100	23	14	♂
153	94	102	23	16	♀
160	96	100	23	14	♂
164	94	98	23	18	♂
165	88	102	23	16	♂
168	101	96	23	15	♂
169	98	91	24	16	♂
185	100	95	23	16	♂
Average 20 males, 98.50 96.65 23.30 16.20					
Average 12 females, 94.66 91.58 22.83 16.66					

GENUS: GOLUNDA.

Golunda ellioti newera. Kelaart.*The Nuwara Eliya Bush-Rat.*

Golunda ellioti. The Indian Bush-Rat. Blanford, No. 299, p. 437.
Golunda ellioti newera. The Nuwara Eliya bush rat. Phillips, Ceylon.
Journal of Science, section B., vol. xiv, part 2, p. 280.

Size.—Size of body about the same as a small Common Ceylon rat, but of a far heavier, more compact, square and clumsy build. Head short and rounded, not pointed or like the snout of a common rat. The tail very short, thick and stumpy, legs and feet short and small in comparison with the size of the body. Ears small and hairy. A very distinct type and form of animal, very different to the ordinary rat.

Fur.—Fine, fairly thick and long, intermixed with many long piles, specially over the centre of the back and towards hinderpart of body. Feet and ears are covered with short thick hairs; tail scaly, with many short stiff hairs. Whiskers short, very fine and not numerous.

The skin is very tender, easily torn and extra care must be taken when skinning and preserving these small mammals.

Specimens collected here, were all in very fine condition and showed layers of thick, white, and very greasy fat when being skinned. They have a fairly strong and quite peculiar smell, very different to any rat or mouse I have handled.

NOTES ON SOME LITTLE-KNOWN CEYLON MAMMALS 611

Colour.—Upper parts darkish brown, intermingled with reddish-yellow, finely speckled all over, which gives a very pretty appearance. The longer piles are coal black. Underfur is soft and of a dirty blue-grey colour. The underparts are a dirty grey, yellowish blue, and quite distinctive. Teeth are orange yellow.

Identification.—This bush rat is easily identified, (specially if once handled) by the very short, thick tail, the squat clumsy and heavy, soft body. Even when dead for some time, the body feels much softer to the hand than the fairly hard, stiff body of a common rat.

Remarks.—At one time this rat seems to have been fairly numerous, and was well-known to the older generation of planters as the 'Coffee rat', which did considerable damage to the young coffee plants, buds and blossoms of the coffee tree.

At the present time it does not seem common round here at all, while I much doubt if many of the present-day planters have ever come across or seen this one-time enemy and serious pest.

Personally I had never seen one here during the last thirteen years and was most interested when at last some specimen of this pretty little animal were collected, and duly identified for me by Phillips as the Nuwara Eliya bush-, or Coffee-rat.

The seven specimens taken here so far, were all trapped with coconut, one being caught by the garden cooly, all in very high and long Paspalum grass which borders the boundary of the high jungle near the gardens. The stomach contents make me believe that they too have a great liking for the cabbages in our vegetable garden.

They are said to often live in pairs, but I have been able to take only two males during the last two months.

Measurements :

Phillips gives the averages of 3 males, as—

length of head and body ...	...	...	135	mm.
length of tail ...	...	...	113	mm.
hind foot ...	...	...	27	mm.
ear ...	...	...	17.6	mm.

and the measurements for one female, as—

length of head and body ...	...	...	131	mm.
length of tail ...	...	...	100	mm.
hind foot ...	...	...	24	mm.
ear ...	...	...	18	mm.

Measurements of specimen collected here, are—

Coll. Number.	Head and body.	Tail.	Hind foot.	Ear.	Sex.
141	143	91	25	20	♀
149	140	90	27	20	♂
179	133	81	25	17	♀
182	125	89	26	16	♀
188	138	100	25	18	♀
202	136	97	26	18	♂
211	132	102	26	16	♀

Average 2 males, 138.50 93.50 26.50 19
Average 5 females 134.20 92.60 25.40 17.40

Parasites—a few very small red ticks.

GENUS: CROCIDURA.

Crocidura miya. sp. n. Phillips.*The Long-tailed Shrew.**Crocidura miya*.—Phillips. *Ceylon Journal of Science*, Sect. B., vol. xv, Part 2, p. 113.

On June 19, 1931, I was fortunate in taking two specimen of a very interesting shrew, which after careful study, I hoped and expected to be the new and rare species of the long-tailed Ceylon shrew, *Crocidura miya*, which later on was confirmed for me by Phillips to whom the two specimen, one mounted and one in alcohol, were sent for identification.

Phillips gives the Type locality, as Moolgama village, near Galaha, in the Central Province of Ceylon, altitude 3,000 feet.

Measurements of the Type, and adult female, are—

length of head and body	...	...	...	79 mm.
length of tail	...	...	...	88 mm.
hind foot	...	...	...	16 mm.
ear	...	...	...	8 mm.

Measurements of the two specimen collected here, are—

Coll. Number.	Head and body.	Tail.	Hind foot.	Ear.	Sex.
147	83	91	16	9	♀
148	81	94	16	9	♀

It is of interest to note, that the important hindfoot measurement in all three specimen known so far, all females, is exactly 16 mm: in every case.

Nos. 147 and 148, were taken the same night, in a small ravine, at an altitude of about 5,500 feet, in traps baited with coconut, and were at once recognised as quite distinct to other mountain shrews often caught here, by the much longer tail.

So far as is known, *Crocidura miya* appears to be the only Ceylon shrew with a tail longer than the head and body measurement, a fact which makes it easily distinguishable from other shrews.

General appearance is very like the ordinary Mountain shrew, but it would seem to be a finer built little animal.

It is hoped in time to collect some more specimen of this interesting and seemingly rare little shrew, and specially some male specimen so as to make the series complete.

GENUS: FEROCULUS.

Feroculus feroculus Kelaart.*Kelaart's Long-clawed Shrew.*

1850. *Sorex feroculus*.—Kelaart. *J. R. A. S. (Ceylon)* p. 325.

1851. *Feroculus macropus*.—Kelaart *Prod. Faun. Zeyl.*, p. 32.

1891. *Crocidura macropus*.—Blanford. No. 119, page 237.

1928. *Feroculus feroculus*.—Phillips. *C. J. of S.* (section B), vol. xiv, part 2, p. 298.

1929.—*Feroculus feroculus*.—Phillips. *C. J. of S.* (section B), vol. xv, part 2, p. 117.

While writing these few notes on some little-known small mammals in Ceylon, two more specimen of great interest were collected here, both being fine representatives of the rare Ceylon Long-clawed Shrew.

They were taken in very nearly the same place, amongst some weeds and 'cheddy' near the small ravine which waters the gardens here.

NOTES ON SOME LITTLE-KNOWN CEYLON MAMMALS 613

Both specimen were female, in splendid condition, and have been prepared.
Size.—Large, heavily built, much more robust than the common mountain shrew. Well developed front feet with exceptionally long claws to the large and very noticeable pads. Tail much shorter than head and body, clumsy and not slender. Very small ears.

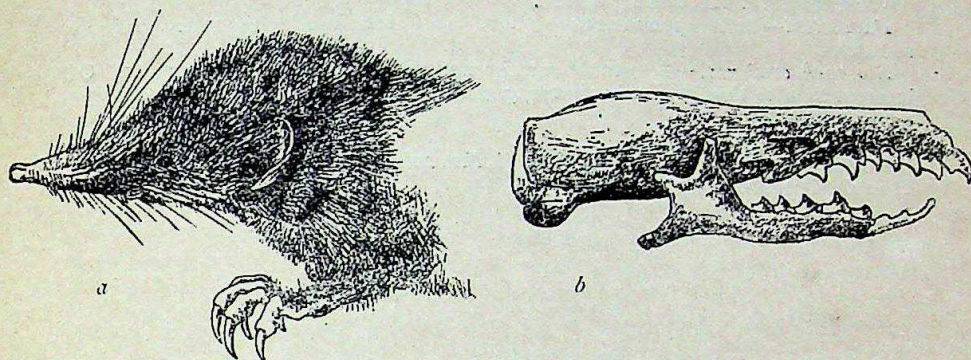


FIG. 1 *a*, Head and forefoot of *Feroculus feroculus*
b. Skull of same.

Colour.—Mole colour, grey-black, the underparts slightly lighter, with a very pretty silvery gloss. Upper lip and chin much lighter, grey to light pink. Front feet white, hind feet grey-pink. Tail dusky with a few minute white hairs at the tip. Ears dirty grey. Claws white with a reddish mark or line, underneath.

Fur.—Very soft and close, like velvet. Several longer, very fine and soft hairs interplanted, specially over the back and towards the tail. Tiny short hairs very sparsely over the toes and feet. Tail covered with minute hairs, interplanted with several much longer hairs, black with silvery tips.

Distribution.—Kelaart caught several of these rare shrews at Nuwara Eliya in 1850, but only one skin, with the skull missing, existed in the British Museum, until Mr. W. E. Wait preserved a fine male specimen, found on the Horton Plains in 1928.

The Genus, of which there is only one species, is entirely peculiar to Ceylon.

Measurements :

...	Head and body.	Tail.	Hind foot.	Ear.	Sex.
Type ...	106.25	56.25	19.4	7.5	?
Mr. Wait's specimen (in spirits) ...	118	72	20	10	♂

Coll. Number.	Head and body.	Tail.	Hind foot.	Ear.	Sex.
214. (6-8-31)	118	73	20	10	♀
218. (8-8-31)	112	71	20	10	♀

FRONT FOOT. LONGEST CLAW.

Mr. Wait's specimen.	12 mm.	6 mm.
No. 214.	13 mm.	5 mm.
No. 218.	15 mm.	6 mm.

Weight of No. 218 was $1\frac{1}{4}$ ounces.

Parasites.—Both specimen taken here were found to have a few minute red ticks.

Stomach contents.—Vegetable matter and what looked like tiny roots. Of interest to note that No. 214 was trapped with coconut bait, while No. 218 was taken with meat.

West Haputale. Ohya.

August 10, 1931.

(Illustration of head and fore-foot of *Feroculus feroculus*, sketched by Miss Hannie Tutein-Nolthenius.)

SOME NOTES ON THE MONITORS.

BY MALCOLM A. SMITH.

(With a plate).

The living Monitors are inhabitants of the Old World, being found in the warm parts of Southern Asia, Africa, the East Indian Archipelago and the Australian region. The large size to which they grow, their general configuration, and in particular the long, slender, bifid tongue, which is retractile into a sheath at the base, as in snakes, are sufficient to distinguish them at once from all other lizards. They have nothing to do with the Iguanas as they are sometimes called, and which do not occur in Asia at all.

The earliest Monitors are known from the Eocene and the bones of fossil forms of somewhat later date and indistinguishable from the species of the present day except that they are larger, have been described by Lydekker from the Siwalik Hills. Some thirty living species are now known, six of which inhabit the Indian Empire.

A critical examination of the specimens in the British Museum (Natural History), the Indian Museum and the Museum of the Bombay Natural History Society which I have recently undertaken has shewn that the distribution of several of the species as given by Boulenger (*Fauna Brit. Ind.*, pp. 160-6) needs correction. His key also for their identification, although admirable when sufficient material is available for comparison, is not so easy when an attempt is made to apply it in the field. It is to be hoped that the new Key given here, when utilized in conjunction with the descriptions given by Boulenger, will enable this difficulty to be overcome.

KEY TO THE SPECIES.

- A. Tail round or slightly compressed posteriorly ; nostril an oblique slit, nearer to the orbit than to the end of the snout ... *griseus*.
- B. Tail compressed, with a low double-toothed crest above.
 - (a) Nostril an oblique slit (sometimes oval in the very young) nearer to the orbit than to the end of the snout.
 - 1. Nostril not twice as near to orbit as to end of snout ; nuchal scales not larger than those on crown of head.
 - Supraoculars not enlarged *monitor*,
 - Median supraoculars transversely enlarged *nebulosus*,
 - 2. Nostril twice as near to orbit as to end of snout ; nuchal scales larger than those on crown of head ... *dumerilii*,

- (b) Nostril nearer to the end of the snout than to the orbit.
 Nostril an oblique slit; nuchal scales larger than those on crown of head;
 snout convex *flavescens*,
 Nostril round or oval; nuchal scales smaller than those on crown of head;
 snout depressed *salvator*.

The distribution of the species is as follows:—

1. *Varanus griseus*. The Desert Monitor inhabits the desert region of N.-W. India and westwards through southern Asia to the Caspian Sea and North Africa. It appears to be not uncommon in parts of Rajputana (Jodhpur, Thar, Pakar, Deesa) and has been obtained as far east as Ambala, Agra, and Narsingarh in the extreme north of the Central Provinces. The specimen in the Museum of the Bombay Natural History Society said to have come from Surat is possibly not correctly labelled as regards its locality.

2. *Varanus monitor*. The Common Indian, or Bengal, Monitor occurs throughout the whole of India, Ceylon, Assam and the greater part of Burma, extending south as far as Tharawaddy and the Henzada district in Lat. 17°30' N. It appears to be equally at home in the plains and in the hills up to 6,000 feet. *V. monitor* is the correct name for this species, usually called *bengalensis*. It was first described by Linnaeus in 1758, his description being based upon some beautiful coloured figures in Seba's Illustrations of Natural History. The drawings are very accurate and there can be no doubt as to the identity of the species. Daudin's *bengalensis* was not published until 1802. (Plate, Figs. 1 & 2).

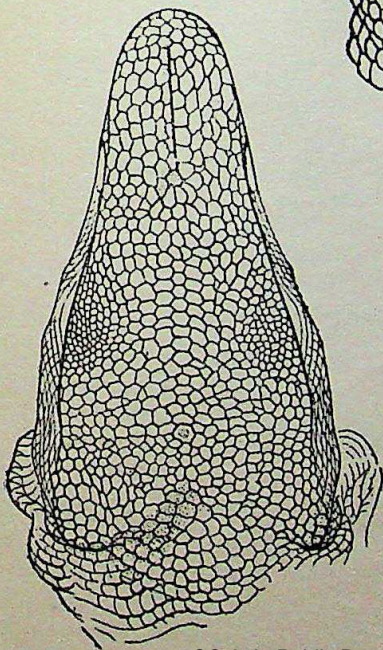
3. *Varanus nebulosus*. The Clouded Monitor is found in southern Burma as far north as Ye (Lat. 15° N.); it is common in the forested areas of northern Siam and extends south throughout the Malay Peninsula. (Plate, Fig. 4).

4. *V. dumerilii*. A Malayan species which reaches Indian limits only in the extreme south of Tenasserim. It has been found in Tavoy and is not uncommon along the coast of Mergui and on the islands of the Mergui Archipelago.

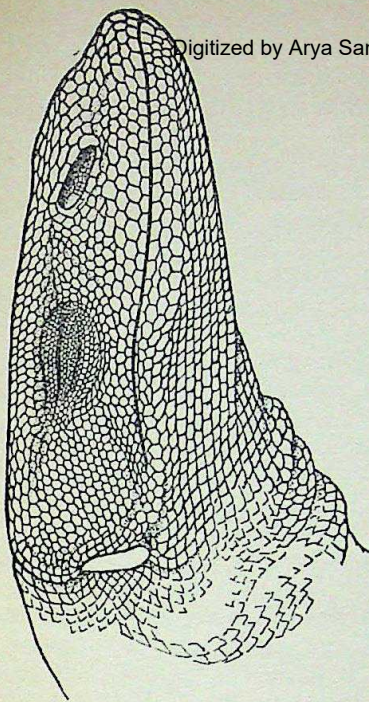
5. *Varanus flavescens*. The rarest of all the Indian species, only a few specimens being known in Museum collections. As its distribution coincides with one of the most densely populated parts of India, it may be that it is being gradually exterminated. I have examined specimens from Ambala, Agra, Saran district, and Goalbathan, Pakur and Midnapur in Bengal. (Plate, Fig. 3). Nothing has been recorded of the habits of this species.

6. *Varanus salvator*, the Water Monitor. Its distribution within Indian limits is unusual and interesting. It is found in Ceylon but is absent from the whole of the Indian Peninsula except in eastern Bengal and the eastern Himalayas. Its occurrence in these districts is probably an extension of its Indo-Chinese range, for it is common throughout Burma and the rest of the Indo-Chinese sub-region.

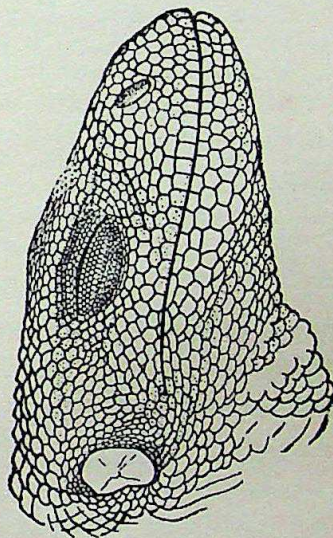
This marked discontinuity in distribution finds a parallel, as far as reptiles are concerned, in *Draco* among the lizards, and *Cylindrophis*



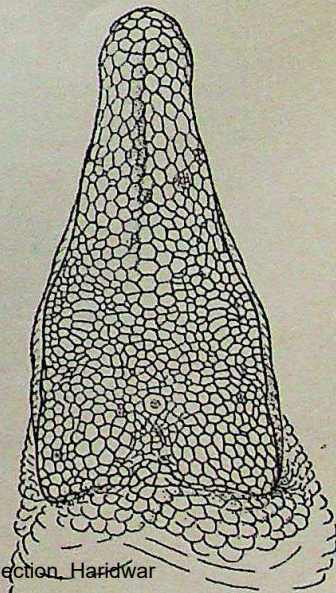
1. *Varanus monitor*.



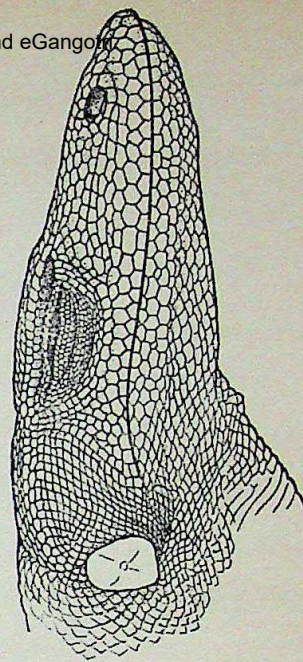
2. *Varanus monitor*.



3. *Varanus flavescens*.



4. *Varanus nebulosus*.



5. *Varanus salvator*.

MONITORS.

among the snakes. The parallel however is generic only and not specific. *Draco dussumieri* occurs in southern India as far north as Madras, *D. maculatus* and *D. norvilli* are found in Assam, the former ranging over the whole of the Indo-Chinese Peninsula. *Cylindrophis maculatus* inhabits Ceylon, *C. rufus*, Burma, Siam and the Malayan subregion. (Plate, Fig. 5).

Mr. H. C. Smith, in a recent article in this Journal (xxxiv, pp. 367-73), has given much interesting information upon the habits of the Burmese species. Of the habits of the species in India nothing has been written.

All the Monitors are carnivorous and they are usually prepared to devour animal food of any kind that they can overcome; indeed, it is astonishing considering the non-distensible nature of their jaws what large prey they can swallow. Birds and their eggs, small mammals, reptiles, fish, crustaceans and even large insects are all readily devoured, and they are not averse to eating carrion. *V. salvator*, when it lives on the coast, spends much of its time hunting along the shore when the tide is out in search of crustaceans and molluscs.

With the exception of *V. griseus* all the Asiatic species are good climbers and take readily to water. *V. monitor* and *V. nebulosus* are both experts at climbing and can ascend the trunks of large trees with surprising ease and rapidity, depending for their hold upon their strong claws and the roughness of the bark. The two species are very closely allied, *V. nebulosus* being apparently the Malayan representative of *V. monitor*, replacing it in southern Indo-China and the Malay Peninsula. The habits of the two are alike. As far as I am aware, they are the only two Asiatic species that are systematically hunted for their flesh. The natives of Siam hunt *V. nebulosus* with dogs in precisely the same manner as the Burmans hunt *V. monitor* (H. C. Smith, p. 369). *V. prasinus* from New Guinea is said to be entirely arboreal in its habits and its bright green hue is no doubt a protective coloration, the result of environment.

V. salvator is more aquatic in its habits than the other species and is thoroughly at home both in fresh and salt water. In the Gulf of Siam I have seen it swimming between islands that were well over a mile apart. *V. dumerilii* no doubt also swims from island to island in the Mergui Archipelago. *V. griseus* is said to dislike water. Whether it drinks it or not I cannot say but in the desert country in which it lives it must often have to go long periods without water. *V. salvator* can be found on Islands where there is no fresh water except that which is provided by the rain during the wet monsoon. The common African Monitor (*V. niloticus*) is said to be able to remain under water for one hour.

In disposition the Monitors are rather timid. When cornered, they have the habit of inflating the body with air and expelling it with a loud and deep hiss, at the same time lashing furiously with the tail. They seem in fact to rely far more upon the tail as a weapon of offence than upon the teeth, though they are capable of giving a very severe bite. Of their powerful claws with which they could inflict considerable injuries they make no use.

Owing to the size to which the Monitors grow, the preservation of specimens in the field, except very young ones, is not an easy

matter. Dried skins are not satisfactory. The best method that I know of is to skin the creature, leaving the head, feet and end of the tail untouched, and then preserve it in spirit (70 per cent) or formalin (2 or 3 per cent). A large skin, when carefully rolled up, can by this means be accommodated in a comparatively small space. Care should be taken, if formalin is used, to transfer the skin to alcohol as soon as possible.

The type of *Varanus* Merrem 1820 is *Lacerta varia* Shaw. The *Stellio* of Laurenti 1768 however has no designated type, and as the genus contains three species which are undoubtedly Monitors, one of which might be selected later as the type, it is necessary to deal with it if the name *Varanus* is to be preserved. In answer to a letter of mine upon this point which I wrote to Dr. Leonhard Stejneger, of the United States National Museum, he has sent me the following, and with his permission I publish it here :—

‘Replying to your letter with regard to the type of *Stellio* Laurenti, I will simply quote from an old MS. of mine, which I think covers the case. This MS., which was intended as a critical study of all the genera in Laurenti’s book with type fixations and synonymies, has been lying unfinished in my desk for many years waiting for a chance to complete it. The part covering the present case runs as follows :—

‘*Stellio* Laurenti includes eight nominal species, none of which can be accepted as type ‘solely upon the basis of the original publication’ (Intern. Code, art. 30, I, a-d). As none of the eight species are excluded from consideration in determining the type (same art. II, e-d) and as nobody apparently has selected as yet a type for Laurenti’s *Stellio* (in contradistinction to *Stellio* Schneider, 1792, or *Stellio* Latreille, 1802) it seems that I am at liberty to designate the type (same art. g). None of the Recommendations of the Code, appended to art. 30, has any direct bearing on the peculiarities of this case.

‘The eight species named by Laurenti were all unknown to him except from Seba’s figures and descriptions. Of these there is no difficulty in identifying *Stellio saurus*, *S. salvator* and *S. salvaquardia* respectively as *Varanus niloticus*, *V. salvator* and *V. monitor* (= *ben-galensis*) of authors. Authors likewise agree that Laurenti’s *Stellio punctatus* is a skink, viz. Linné’s *Lacerta punctata* = *Eumeces punctatus* of Duméril and Bibron—*Lygosoma punctatum* of Boulenger.

‘If Laurenti’s *Stellio* were to be restricted to any of these species, it would supplant either *Varanus* or *Eumeces* or *Lygosoma* respectively, as *Stellio* is the older name, a calamity to be prevented if possible.

‘There remain four species, however, the identification of which is more or less doubtful, viz.

Stellio saxatilis (Seba, II, 79, 4)

Stellio tessellatus (Seba, I, 76, 2) ‘Habitat in Virginia.’

Stellio viridis (Seba, I, 75, 2) ‘Habitat in Virginia.’

Stellio thalassinus (Seba, I, 110, 4 and 5) ‘Habitat in India orientali.’

The first one Merrem (Syst. Amph. 1820, p. 52) renamed *Agama tetradactyla* because it is distinguished by having four toes on fore-feet; the second and third he considered identical and renamed the

compound *Lacerta longicauda*; the fourth one he referred to *Varanus dracæna* (= *Varanus niloticus*) with a query.

'No one has recognised the *Agama* or the *Lacerta* since. An inspection of Seba's figures shows that Merrem's guesses were not fortunate. In the first place, Nos. 2 and 3 cannot well belong to the same genus, as the former has small head scales and a serrated upper edge to the tail, and the latter has large head shields and no upper tail edge. The former may be some Iguanoid, while the latter shows a certain resemblance to *Tupinambis teguixin*. The fourth is almost certainly not a *Varanus*, and while not showing any shields on the head might with greater probability be referred to *Ameiva*. His guess as to the first would seem to be nearer to the truth, especially when one considers the wide limits of the genus *Agama*, as he understood it, but the character insisted on in Seba's description as well as plainly shown in the figure, viz. only 4 fingers renders any attempt at identification futile.

'Under these circumstances rather than to cause a wholesale mix-up of names current for a century, it seems the better policy to select as the type one of the unidentifiable names, a procedure calculated to lay the specter of *Stellio* becoming active again in herpetological nomenclature. With this in view I designate *Stellio saxatilis* Laurenti the type of *Stellio* Laurenti, Syn. Rept., 1768, p. 56.'

I cannot agree with Dr. Stejneger and other authors that Laurenti's *Stellio salvaguardia*, based on Seba I, 101, represents *Varanus monitor*. The position of the nostril alone, which is at the extreme tip of the snout, is sufficient to justify this view. *Lacerta dracæna* Linnæus, II, 1766, p. 360, referred by authors, with a query, to *V. monitor* = *bengalensis*, is in the same position, for it is based upon the same figure in Seba's 'Illustrations.' On the other hand, Laurenti's *Stellio thalassinus*, based on Seba. I, 110, 4 and 5, might well stand for *Varanus monitor*.

THE BUTTERFLIES OF THE SIMLA HILLS

BY

G. W. V. DE RHE-PHILIPPE, F.E.S.

Part III

(Continued from page 429 of this Volume)

LYCAENIDÆ

This family, which includes all the Blues, Coppers and Hairstreaks, is, as might be expected, very well represented in the Simla Hills. The palearctic element, which prevails in Kashmir and to the North-West, is here still very strong; but a number of Indo-Malayan forms are also to be found. Speaking broadly, the species of the *Lycaeninae* group affect the open spaces—gardens, meadows and grass-lands and are, for the most part, rather common and much in evidence; while the insects of the other groups keep to the forests and wooded valleys and nullahs and have to be searched for.

152. *Castalius rosimon rosimon*. Fabricius.

(Bing. 766; deN. 759; Ev. H14 (1)).

This beautiful blue belongs rather to the plains of Southern, Central and Eastern India than to the hills. It is not particularly common so far to the north-west, but some may be found along the foot of the hills at almost any time of the year.

153. *Tarucus theophrastus nara*. Köllar.

(Bing. 762; deN. 752, 753; Ev. H15 (2)).

Common in the plains and submontane tracts, less so in the hills. Anyone looking out for blues is, however, sure to pick up several each year. Is more often seen after the rains and flies in gardens and round meadow flowers.

154. *Tarucus venosus*. Moore.

(Bing. 763; deN. 757; Ev. H15 (3)).

Considerably rarer than the last, but taken occasionally in the valleys below 5,000 ft. I have it from the Sutlej below Narkanda (September) and from the valley below Kasumpti (October).

155. *Euchrysops cnejus*. Fabricius.

(Bing. 761; deN. 745-749; Ev. H16 (1)).

Very common in the plains and the outer hills, less so in the inner hills to about 8,500 ft. Flies summer and autumn and, like other species of the group, is fond of fields and roadside hedges.

Euchrysops pandava pandava. Horsfield.

(Bing. 760; deN. 750; Ev. H16 (3)).

Recorded from the Himalayas, but the Simla Hills seem to be rather beyond its extreme westerly range. It is rare in the Mussoorie Dun where I have taken only one or two, but may possibly extend along the lower hills into our limits. I have noticed that it is fond of leguminous trees and shrubs.

156. *Everes argiades diporides*. Chapman.

(Bing. 735 ; deN. 716 ; Ev. H17 (1)).

Probably more common than would appear from the number actually caught, but it is a small inconspicuous insect which escapes notice. I have taken a few, usually in meadows, in the autumn months between 6,500 and 9,000 ft.

*157. *Everes dipora*. Moore.

(Bing. 735 ; deN. 716 ; Ev. H17 (2)).

The recorded range is from 'Kashmir to Northern Burma', but seems to be very rare in the Western Himalayas and not common anywhere. I have no personal knowledge of its appearance anywhere west of Sikkim.

158. *Lycænopsis (= Cyaniris) vardhana*. Moore.

(Bing. 685 ; deN. 675 ; Ev. H20 (2)).

Not uncommon in this district at elevations between 6,000 and 9,000 ft. and the observant collector will usually secure all the specimens he needs. There were one or two places about Mashobra, Mahasu and Kufri where I generally found quite a number at some periods of the year. May and June are the best months, but a few may also be seen after the rains. Likes wooded surroundings as a rule, and I have noticed that the Pierid, *Gonepteryx zancka*, is often found in the same spots.

159. *Lycænopsis albocærulea*. Moore.

(Bing. 689 ; deN. 678 ; Ev. H20 (6)).

This species is here at its western limits and is distinctly rare in the Simla Hills. My notes show only one taken on the road to Chail in October.

160. *Lycænopsis puspa gisca*. Fruhstorfer.

(Bing. 691 ; deN. 681 ; Ev. H20 (15)).

This butterfly, which is so common in most places within its range, is comparatively rare in these hills. Is rather more likely to be found in the lower valleys, but has been taken in Simla and as high up as Kufri and Fagu. Summer and autumn.

161. *Lycænopsis cardia dilecta*. Moore.

(Bing. 701 ; deN. 689 ; Ev. H20 (18)).

Like *albocærulea*, is here at the western limits of its range and is very rare. I can record one specimen only, a worn male taken near Kufri village in October.

162. *Lycænopsis huegellii huegellii*. Moore.

(Bing. 704 ; deN. 690 ; Ev. H20 (19)).

No one who takes the least interest in the Simla butterflies can help noticing this beautiful blue. It abounds at nearly all times from March right on to December, flying about the gardens, roadside hedges and shrubs and the sunny clearings in woods. I have seen it as low down as Dharmapore (3,000 ft.) and have taken it at 12,000 ft. on the summit of Huttoo.

163. *Lycænopsis argiolus coelestina*. Kollar.

(Bing. 703 ; deN. 688 ; Ev. H20 (20)).

Common from the spring to the late autumn and found very nearly everywhere except deep forest from 2,000 to 12,000 ft.

164. *Lycæna astrarche*. Bergstrasser.

(Bing. 705 ; deN. (as *medon*) 647 ; Ev. H23 (9)).

Very plentiful from spring to autumn and to be seen even on warm days in the winter months. Likes open, sunny places and flutters about gardens and the low vegetation along the roads and in meadows.

165. *Lycæna galathea galathea*. Blanchard.

(Bing. 716 ; deN. 665 ; Ev. H23 (15)).

Common in Kashmir, but getting rarer towards the east and distinctly uncommon here. It will be confined to the inner hills. I know of one or two taken beyond Narkanda. Is mainly a spring and early summer butterfly.

*166. *Lycæna pheretes lehana*. Moore.

(Bing. 719 ; deN. 664 ; Ev. H23 (16)).

A species of the high mountains of the interior. It is not likely to be found in the Simla Hills much below 10,000 or 12,000 ft. and must therefore be looked for on the ranges beyond Narkanda and Baghi.

*167. *Lycæna eros ariana*. Moore.

(Bing. 709 ; deN. 649 ; Ev. H24 (2)).

I have not taken this myself within our area, but it is not uncommon in Kulu and Lahoul and is said to come down to 8,000 ft. in Kumaon so it should certainly be found. I expect the best place to look for it would be in the grass country round Matiana, Narkanda and Baghi in the early summer.

168. *Chilades laius laius*. Cramer.

(Bing. 728 ; deN. 672 ; Ev. H21).

A very common butterfly in the plains and fairly plentiful from spring to autumn in the tracts at the foot of the hills wherever the lime trees grow. Does not, to my knowledge, extend any distance into the hills.

*169. *Zizera trochilus trochilus*. Freyer.

(Bing. 729 ; deN. 673 ; Ev. H22 (1)).

Is generally common in grass country in the plains and lower hills, though it is usually overlooked owing to its very small size and insignificance. I have not taken it inside our district but it is certain to be found in suitable places round Kalka.

170. *Zizera maha maha*. Kollar.

(Bing. 721 ; deN. 694 ; Ev. H22 (2)).

Very common in the plains and in the country bordering on the plains throughout the year. Extends, though not quite so abundantly, into the hills to at least 9,000 ft., especially in the autumn months. Flies weakly about sunny gardens and grass slopes.

171. *Zizera lysimon*. Hubner.

172. *Zizera galka*. Fabricius.

173. *Zizera otis otis*. Fabricius.

(Bing. 722-24 ; deN. 699, 702, 703 ; Ev. H22 (3 to 5)).

All these three are really butterflies of the plains, but spread into the outer hills and will be found round Kalka and probably as far as Dharmapore and Solon. Rough grass country is the place to look for them.

174. *Syntarucus plinius*. Fabricius.

(Bing. 764; deN. 758; Ev. H27).

Not uncommon before and after the rains but, like many of the less prominent blues, often escapes notice. Flies about gardens and shrubs and bushes in the open.

175. *Catachrysops strabo*. Fabricius.

(Bing. 759; deN. 743; Ev. H28 (1)).

A plains insect and more or less common along the lower hills, but also found occasionally in Simla and beyond up to nearly 10,000 ft. Spring to autumn.

176. *Lampides* (= *Polyommatus*) *bæticus*. Linnaeus.

(Bing. 772; deN. 767; Ev. H29).

Common up to 10,000 ft., summer and autumn. The specimens found in the hills do not seem to run to the same size as in the plains where it literally swarms in the spring months.

* 177. *Nacaduba nora*. Felder. (= *ardates*. Moore.)

(Bing. 746; deN. 730; Ev. H30 (14)).

Nacaduba dubiosa indica. Evans.

(Ev. H30 (15)).

Nacaduba noreia hampsoni. DeNiceville.

(Bing. 743; deN. 732; Ev. H30 (16)).

The *Nacadubas* are a difficult genus and Evans' recent rearrangement has meant some reshuffling of the names under which some species were listed by the older authorities. The three mentioned above are the only ones likely to be found in our limits. DeNiceville records *ardates* from Poonch in Kashmir, but I can find no other definite report of any of them having been taken quite so far to the west. I have *nora* (or *ardates*) from the Kumaon and Garhwal terais and *hampsoni* from the Mussoorie Dun, but these are the nearest localities I can vouch for. They may possibly turn up along the foot of the hills; but will, in any case, be very rare.

Jamides bochus bochus. Cramer.

(Bing. 751; deN. 733; Ev. H31 (1)).

Jamides celeno celeno. Cramer.

(Bing. 756; deN. 738; Ev. H31 (6)).

Both these are continental and eastern Himalayan and, as far as I know, there has yet been no definite record from the Simla Hills. Both are to be had in the Mussoorie Dun and their appearance a little bit further west is a possibility. They would only be found in damp, wooded places at the foot of the hills.

178. *Azanus ubaldus*. Cramer.

(Bing. 725; deN. 707; Ev. H32 (1)).

179. *Azanus uranus*. Butler.

(Bing. 726; deN. 708; Ev. H32 (2)).

Both these species are fairly common in the Punjab plains and extend a little way into the outer hills, but are much scarcer. They will be found, usually in the autumn months, around the babul trees in the jungle near Kalka.

*179. *Azanus jesous gamra*. Lederer.

(Bing. 727; deN. 709; Ev. H32 (4)).

A much rarer species of the genus and one I have not taken anywhere in India. It is more a southern and western India insect, but deNiceville records it from Ambāla and there is just a chance it may be found with the other two near Kalka.

180. *Heodes (= Chrysophanus) pavana*. Kollar.

(deN. 879; Ev. H35 (1)).

Very common, spring to autumn, from 6,000 ft. to the inner ranges. It may be seen every day in gardens, round road side vegetation and in sunny meadows.

181. *Heodes phlœas indicus*. Evans.*Heodes phlœas flavens*. Ford.

These are two very slightly differentiated forms of the species more familiarly known to us as *phlœas timeus*. Cramer. Very common at all times except the midwinter months, *indicus* predominating in the outer ranges and *flavens* in the interior, though they overlap considerably.

*182. *Heodes kasyapa*. Moore.

(deN. 881; Ev. H35 (7)).

This beautiful 'Copper' is common in Kashmir, less so in Lahoul and Kulu, and very much scarcer further east. Has been recorded by deNiceville as taken 'on the Himalaya Tibet road near Simla' and Evans extends its range to Mussoorie. I have never taken it myself in the Simla limits nor heard of a capture within recent years. On the analogy of its habits in Kashmir, it is most likely to be found in the summer in open spaces in woods at elevations of not less than 8,000 ft. and should be looked for in such surroundings in the Matiana-Narkanda-Baghi country.

183. *Heliothorus (= Ilerda) sena*. Kollar.

(deN. 883; Ev. H36 (1)).

Very common spring to autumn. Flies round low vegetation by road sides and in meadows and waste ground.

184. *Heliothorus oda oda*. Hewitson.(deN. 885; as *tamu*; (Ev. H36 (4)).

Common in Kashmir and fairly so in Kumaon, but seems to be rare in the intervening country. I have taken it on Summer Hill and in the Mahasu woods, but saw very few in the course of all my butterfly collecting in Simla. I have seen it only in the spring and summer.

185. *Heliothorus androcles coruscans*. Moore.

(deN. 887; Ev. H36 (5)).

This beautiful insect, very aptly called the 'Green Sapphire' by Evans, is not uncommon in the summer months, though it also flies, much less frequently, after the rains. I found some of the nullahs on the north side of the Mahasu ridge were good spots for this butterfly, but it also comes sometimes into gardens.

*186. *Strymon sassanides*. Kollar.

(deN. 862; Ev. H39 (1)).

Is said to be not rare but somehow I have never come across it. Its real home is further to the north-west.

*187. *Euaspa milionia*. Hewitson.

(deN. 876 ; Ev. H41)

Another not uncommon butterfly which, however, I was never able to find. DeNiceville records it as single brooded and flying in May and June. I understand it keeps to damp and shady surroundings where there is bush growth.

188. *Thecla icana*. Moore.

(deN. 871 ; Ev. H42 (1)).

I have a male from Narkanda taken in August, and Col. Evans has caught it on Kufri Hill, also, I believe, in the autumn. The late Col. Chaldecott took several on the Jalauri Pass in August and September. Is not common anywhere.

189. *Thecla bieti dohertyi*. DeNiceville.

(de N. 872 ; Ev. H42 (2)).

Ranges 'from Kulu to Garhwal' but appears to be confined to the inner hills. Col. Chaldecott took a few on the Jalauri Pass at 10,500 ft. in August. This is the only definite record I have of its actual appearance in our neighbourhood.

*190. *Thecla ataxus ataxus*. Doubleday.

(deN. 865 ; Ev. H42 (4)).

Is said to occur from Murree to Kumaon, but is a very rare butterfly which I have not come across.

191. *Thecla birupa*. Moore.

(deN. 870 ; Ev. H42 (12)).

Simla is the western limit of the range of this species and, though fairly common in Kumaon and the Mussorie hills, it is distinctly scarce in our area. I have taken only one or two, flying round the small brown oaks on Kufri Hill in June.

192. *Thecla syla syla*. Kollar.

(deN. 869 ; Ev. H42 (14)).

The only really common species of the genus in Simla and the neighbourhood. It will be found in nullahs and wherever there are oak trees, from 6,000 to 10,000 ft. Flies both before and after the rains.

193. *Thecla ziha*. DeNiceville.

(deN. 874 ; Ev. H42 (18)).

Another very rare butterfly. I know of only one taken in Simla and I myself have not seen it. All the records point to its being a summer butterfly.

194. *Chaetoprocta odata*. Hewitson.

(deN. 877 ; Ev. H43).

If you can hit upon one of the walnut trees which this little chap has taken into favour, you will get as many as you want in an hour or two. It does not, however, distribute itself generally over the country and is abundant only for a very short season in June.

*195. *Curetis acuta dentata*. Moore.

(Bing. 774 ; deN. 858 ; Ev. H45 (6)).

This is an insect which has hitherto been looked on as a variety of the changeable *C. bulis*, Doubleday and Hewitson, but Evans has recently separated it as a distinct species. *Bulis* itself has been reported from Mussoorie, but I do not think it is likely to be found as far west as Simla. DeNiceville has

recorded *dentata* from Mandi and it is certainly common in the Mussoorie Dun. I can trace no definite record of its appearance in the intervening country, but have no doubt it will be found in the lower hills and valleys.

196. *Iraota timoleon timoleon*. Stoll.

(deN. 775, 776 ; Ev. H46 (1)).

deNiceville records this from Dalhousie and Dagshai and I got a dwarfed and worn specimen one May on the Kasauli road above Kalka. It is always rare in this part of India.

197. *Arhopala* (= *Amblypodia*) *dodonæa*. Moore.

(deN. 817 ; Ev. H50 (51)).

198. *Arhopala rama rama*. Kollar.

(deN. 807 ; Ev. H50 (52)).

These two, which have at various times been taken to be dimorphic forms or as the male and female of the same species, are so similar in their habits and haunts that they might well be dealt with together. Their respective specific rank is now well established, but they have much in common and they are often, in flight, mistaken for each other. Both are particularly addicted to wooded nullahs where there is running water, and they frequently settle on damp patches of ground and on the bushes round. They are usually common in such surroundings ; but both, and especially *rama*, may also be found in oak woods and flying into gardens. The best season is before the monsoon, *dodonæa* usually appearing a trifle later than the other ; but they also fly, rather less commonly, from August to October.

199. *Arhopala ganesa ganesa*. Moore.

(deN. 836 ; Ev. H50 (66)).

Habits and seasons much the same as those of the last two species. Its special haunts are damp, shaded nullahs in wooded country, but it may sometimes be taken round oak trees. May and June are the best months, but individuals may occasionally be seen till October.

*200. *Surendra quercetorum quercetorum*. Moore.

(deN. 778 ; Ev. H51 (1)).

Evans gives the Dun as the westerly limit of the range of this butterfly. It is comparatively common there in low jungle along the foot of the hills. Though there is no authentic record of its appearance further west, I should not be surprised if it yet turns up in the very similar country round Kalka.

* 200. *Apharitis lilacinus*. Moore.

(deN. 907 ; Ev. H57 (3)).

This is really a Central India butterfly, and I was very surprised to see that Col. Evans mentioned Hardwar and Kasauli as places where it had been taken. I include it in the list on his authority, but its appearance here must be very exceptional.

201. *Spindasis* (= *Aphnæus*) *vulcanus vulcanus*. Fabricius.

(deN. 903 ; Ev. H58 (1)).

Mainly an insect of the plains, but will always be found, though never plentifully, in the lower hills from Kalka to Dharmapore and Sabathu and, rarely, even as high up as Simla and Mashobra. I have taken one or two specimens in June. It keeps to open, sunny surroundings and flies about shrubs and low trees.

* 202. *Spindasis ictis ictis*. Hewitson.

(deN. 914 ; Ev. H58 (5)).

I have not seen this in the Simla district. DeNiceville records it from Mandi in the Western Himalayas and it should occur but must be very rare.

203. *Spindasis elima uniformis*. Moore.

(deN. 919 ; Ev. H58 (6)).

Said to be not rare but I have only come across it once in our area when I took a specimen on the eastern slopes of the Chail ridge in June. It is fairly common between Mussoorie and Chakrata in the autumn and, since it extends to Kashmir and Chitral, one would expect to pick it up more frequently here. Like all the *Spindasis*, it flies fast and settles unobtrusively and calls for a quick eye for detection and capture.

* 204. *Spindasis nepalicus nepalicus*. Moore.(deN. 923 as *zaffra* ; Ev. H58 (8)).

deNiceville has recorded this insect from Kulu in June and Mackinnon from Mussoorie in May. It is rare and I have not seen it within the district.

Spindasis lohita. Horsfield.

(deN. 910 ; Ev. H58 (12)).

DeNiceville refers to *lohita* as being found throughout the Himalayas, while Evans states that the Himalayan local race, *himalayanus*, Moore, is to be found only from Sikkim eastwards. I have taken one or two of the *lohita* group at Ranibagh in Kumaon, but I doubt very much whether any will be found as far to the west as Simla.

205. *Pratapa* (= *Camena*) *icetas icetas*. Hewitson.

(deN. 897 ; Ev. H61 (5)).

A rarity throughout its range from Kashmir to Kumaon. DeNiceville mentions captures on Tara Devi. Coming to more recent years, my notes record three only—two on Summer Hill and one at S. Damiano, Mashobra. These three were all in open spaces in woods between June and August.

Tajuria cippus cippus. Fabricius.(deN. 931 as *longinus* ; Ev. H65 (6)).

Tajuria is a genus which belongs rather to the Eastern Himalayas and Malaya and *cippus* is the only one of its species at all likely to be found so far west. It is stated to occur throughout the outer Himalayas, but I cannot trace any authentic record of its appearance in the Simla Hills. I have taken it in Kumaon and know of a capture near Saharanpore. It may turn up at lower elevations in the District.

206. *Horaga onyx onyx*. Moore.

(deN. 960 ; Ev. H82 (1)).

Kulu, Kangra and Dehra Dun are all mentioned as places where this butterfly has been taken, so it should occur in the intervening tracts. I have seen one in a collection at Simla but the exact locality was not given. I have not myself found it in this part of the country, and it is presumably very rare here.

* 207. *Horaga viola*. Moore.

(deN. 965 ; Ev. H82 (4)).

A species which ranges from Kangra to Burma but is rare everywhere. I have never found it in the Simla Hills and cannot trace any definite record of a capture here.

208. *Deudoryx epijarbas ancus*. Fruhstorfer.

(deN. 986; Ev. H88 (1)).

Not uncommon in June and July. Though strong and rapid fliers, they are easy to catch as they are fond of coming into gardens and settling on flowers. I took several in this way.

209. *Virachola perse perse*. Hewitson.

(deN. 1013; Ev. H89 (3)).

Occurs from Kangra eastwards, but is very rare here near the westerly limit of its range. One taken 'somewhere near Kalka' by a soldier collector is the only actual case of capture in the district that I know of. It is elsewhere fond of guava plantations, and these will be the best places to look for it. Will not usually be found much above the 3,000 ft. level.

* 210. *Rapala varuna grisea*. Moore.

(deN. 999; Ev. H90 (10)).

A rare butterfly. I have only taken it at low elevations in Kumaon, but there is a record of a capture in Kangra and it should be found in the country between.

* 211. *Rapala melampus*. Cramer.

(deN. 1006; Ev. H90 (15)).

Occurs at low elevations from Murree eastwards, but is rare west of Mussoorie. I have not taken it in the district.

212. *Rapala nissa nissa*. Kollar.

(deN. 1002; Ev. H90 (18)).

Quite the most common representative of the genus in the Simla Hills. They were sometimes to be taken in plenty dashing round and settling on low growing shrubs in some of the wooded nullahs behind Jakko and Mahasu in June and July just before the rains. Occasionally come to the flowers in gardens. I have not seen it below 6,000 ft. in the Simla Hills.

213. *Rapala micans selira*. Moore.

(deN. 990; Ev. H90 (19)).

Not uncommon. May, between May and September, be picked up at any time and anywhere except very bare country. Seems to be specially attracted by wild indigo flowers. Does not appear to venture below 5,000 ft. and will probably be found up to 10,000 ft.

* 214. *Sinthus chandrana chandrana*. Moore.

(deN. 1017; Ev. H91 (2)).

* 215. *Sinthus nasaka pallidior*. Fruhstorfer.

(deN. 1015; Ev. H91 (3)).

Both have been recorded from 'Kangra to Kumaon' and as being rare. I have not found any of the genus anywhere west of Sikkim. They appear to fly only in the spring and summer and will probably not be found below 5,000 ft.

HESPERIDÆ

The 'Skippers,' as a general rule, receive very little attention from the ordinary collector. The butterflies of which the family is composed are, with a few exceptions in the Indo-Malayan groups, small, dingy and inconspicuous

insects. Only a small proportion of the numerous species display any partiality for open country or venture into gardens and habited places. Most of them and all the finer species, avoid flying in the open and prefer to hide in wooded ravines and forest clearings which are not easy of access. Several species fly only in the early mornings or in the dusk of twilight.

It is therefore not a matter for surprise that the family should be poorly represented in most collections. Only in the Natural History museums and in the larger specialist collections is it given the place it should have; and even these are often not as complete as their curators would wish.

It is possible that greater interest might have been stimulated had either DeNiceville or Bingham been able to complete their works on the butterflies of India. But neither ever reached the *Hesperidae*; and the few collectors who did take notice of the skippers had to work under handicap. Watson's *Hesperidae Indica* furnished descriptions, but it lacked a key and, in the light of our later knowledge, was very incomplete. He later supplemented the book with a key which appeared in the *Journal of the Bombay Natural History Society* in 1895; and this, with the *Revision of the Oriental Hesperidae* published by Elwes and Edwards in the Transactions of the Zoological Society in 1897 provided the means for diagnosing and recognising the various members of the family. Unfortunately these and the notes and descriptions of genera and species which appeared from time to time in the *Journals of the Bombay N. H. Society* and in other scientific magazines and proceedings seldom reached the ordinary collector.

We are in a better position now. Moore's *Lepidoptera Indica* has been completed though its expense puts it beyond the reach of most; and Evans, in his *Identification of Indian Butterflies* has, after much research, worked out a comprehensive and up-to-date key which will be invaluable. A handbook with descriptions of species is, however, still badly wanted; and it is to be hoped that the *Fauna of India* series will soon be completed to meet the need.

The North-West of India—plains and hills—is not a prolific Hesperid country. Still Evans, whom I follow throughout in the list below, has been able to specify thirty species as occurring in the stretch from Kangra to Mussoorie which includes the Simla Hills. It is probable that some others, either of the Palearctic type of the north and north-west or of the Indo-Malayan groups which extend into Kumaon and Mussoorie, will yet be discovered in the Simla district.

Information as to the habits, seasons of appearance and particular localities affected by species of a family which has been so neglected by the generality of collectors is necessarily scanty. It is not as complete, as applicable to the Simla district itself, as I would wish; but I am able to supplement it to some extent by the analogy of the ways of the species or connected races in localities where my opportunities for field observation have been greater. I am also indebted to General Evans for some notes of his own experiences of the *Hesperidae* in the Simla Hills.

The references, other than those to Evans' *Identification*, are to Watson's *Hesperidae Indica* or to Journals where detailed description of the butterfly may be found.

216. *Hasora alexis alexis*. Fabricius.

(Ev. i. 1 (12); Hesp. Ind. 19).

Occurs in the plains and foothills, but is very local in its habits. A species of low tree seems often to attract it and I have found it flitting round these in the Punjab plains and once on the railway line just above Kalka. It usually appears during or just after the rains and flies more freely in the evening than by day.

Bibasis sena sena. Moore.

(Ev. i. 3; Hesp. Ind. 17).

This species has a wide range throughout Eastern and Continental India and along the Himalayas westward as far as Mussoorie. Though not yet recorded from the Punjab, I should not be surprised if it is found by someone who has opportunities for sedulously working the country along the foot of the hills,

217. *Rhopalocampta benjaminii benjaminii*. Guerin.

(Ev. I. 5; Hesp. Ind. 3).

This beautiful skipper is fairly common in Sikkim and Assam but is distinctly rare in the Central and Western Himalayas. It is possible that it is less a rarity than it appears to be; but it is one of the species which seems to fly only in the very early morning and therefore escapes notice. I have only taken one in the Simla region. It was quite an unexpected find. Travelling up by the Railway one June, the train halted in the early morning at Koti station; and, while it waited, I saw a butterfly settle on some shrubs near. I had no net, but managed to knock it down with my hat; and was delighted to discover it was a male '*benjaminii*.' I have taken it from early spring to autumn in the Khasi Hills.

218. *Badamia exclamatoris*. Fabricius.

(Ev. I. 6; Hesp. Ind. 1).

Generally common throughout India and extends into the hills to 7,000 ft. at least, though it is rarer here. I have seen it in Simla. Occurs summer and autumn, and flies very rapidly around low trees and hedges. The larva feeds on a species of *Bignonia*.

*219. *Celaenorrhinus pulomaya*. Moore.

(Ev. I. 16 (5); Hesp. Ind. 185).

Recorded from Kangra to the Naga Hills. I have never come across it anywhere west of Sikkim, and Evans tells me he never took it in Simla.

220. *Celaenorrhinus leucocera leucocera*. Kollar.

(Ev. I. 16 (13); Hesp. Ind. 192).

Common in the east and central Himalayas, less so in the western. It usually keeps to shaded nullahs and forest glades during the day, but sometimes flies into Simla gardens at dusk. I have only noticed it after the monsoon.

*221. *Celaenorrhinus munda*. Moore.

(Ev. I. 16 (15); Hesp. Ind. 194).

Said to be not rare from Murree eastwards, but neither Evans nor I ever took it in the Simla district and I have not seen it anywhere west of Kumaon. Would have the same habits as the preceding; and, since it is superficially like it, might easily be mistaken for *leucocera* if only seen in flight.

*222. *Achalarus bifasciatus casyapa*. Moore.

(Ev. I. 18 (2); Hesp. Ind. 224).

A western Himalayan butterfly which is very rare everywhere in its range. I have only a single specimen, taken in Mussoorie in July, as a result of many years' collecting. I found the eastern race, *liliana*, not very rare in Shillong where it was much addicted to flying in the neighbourhood of waterfalls, in and out of the spray.

Satarupa sambara dohertyi. Watson.

(Ev. I. 19 (2); Hesp. Ind. 130).

Though not yet recorded from anywhere west of Mussoorie, it is just possible that it may be found very rarely in the Simla district. Its haunts would be near wooded streams at low elevations.

Tagiades atticus khasiana. Moore.

(Ev. I. 20 (1); Hesp. Ind. 136).

A wide spread species which is usually common where it occurs. Though not yet reported from anywhere west of the Mussoorie Dun, a rare straggler or two may possibly find its way into the similar country along the foot of the Simla Hills.

*223. *Tagiades menaka*. Moore.

(Ev. I. 20 (8); Hesp. Ind. 141).

Found along the Himalayas from Kashmir to Burma and China, but is common only in the east. I got a solitary specimen at 6,000 ft. below Dalhousie and found it fairly plentiful at low elevations in Kumaon; but have never seen it anywhere in the intervening tract. Evans notes it as 'rather rare' in the Simla Hills; and it certainly needs a lot of looking for. It keeps to damp, wooded glens, preferably near water; and its snow-white hindwings make it conspicuous as it flashes about in these surroundings. It settles suddenly with outspread wings on the underside of a leaf and, in doing so, disappears as if by magic. I have taken it from spring to autumn where it is common.

It is worth while noting that, though the next species, *T. litigiosa litigiosa*. Mosch., is supposed to be restricted to the Eastern Himalayas, I have taken typical specimens below Mussoorie and in Kumaon.

224. *Coladenia dan fatih*. Kollar.

(Ev. I. 25 (2); Hesp. Ind. 169).

Should not be rare but is very seldom seen. I have only one specimen from the district—taken in the nullah near Barogh in August. It affects damp country with plenty of undergrowth; and, like the last, flies quickly and settles suddenly.

*225. *Sarangesa purendra*. Moore.

(Ev. I. 26 (2); Hesp. Ind. 71).

Has a range from Kangra to Kumaon and is said not to be rare. I have, however, not found it common anywhere and neither Evans nor I ever got it in the Simla district. The few specimens I have secured in other districts have always been before the monsoon in rather dry scrub country at the foot of the Hills. Such a small greyish insect easily escapes notice.

226. *Sarangesa dasahara dasahara*. Moore.

(Ev. I. 26 (3); Hesp. Ind. 72).

The races of *dasahara* are found all over India except the extreme north-west and are generally common everywhere. I have only one from the Simla region—taken at Kalka in May—but it is probably not uncommon in the outer hills and the plains adjoining. Being, like the last, very inconspicuous, it wants looking for.

*227. *Odontoptilum angulata*. Felder.

(Ev. I. 31 (1); Hesp. Ind. 153).

Common from Kumaon eastwards but distinctly rare in the Western Himalayas. I have not taken it in the Simla Hills, and Evans tells me he also had not found it here. I have caught it at 5,000 ft. near Mussoorie, but it is more likely to occur in the lower valleys round Kalka. Flies spring and autumn.

Caprona ransonnetii potiphera. Hewitson.

(Ev. I. 32 (1); Hesp. Ind. 149).

Never actually recorded from these hills, but it has been noted from the Punjab and I have taken it in the Mussoorie Dun, so that there is considerable chance of its turning up in the country round Kalka.

228. *Hesperia galba*. Fabricius.

(Ev. I. 34 (1); Hesp. Ind. 220).

I have not taken this myself anywhere in the Simla district, and Evans notes it as 'rare'. I have only taken it elsewhere in the plains and the country bordering on them, so I fancy it is more likely to be found in the tracts round Kalka. It flies both spring and autumn and affects open grass meadows.

Though no other *Hesperia* has yet been recorded from the Simla Hills, I think it is more than probable that one or two of the palearctic species, such as *H. alpina cashmirensis*, Moore, which are found in Turkestan, Tibet and Kashmir, will be discovered in the high interior country.

* 229. *Aeromachus inachus stigmata*. Moore.

(Ev. I. 58 (2); Hesp. Ind. 94).

Said to be found throughout the Himalayas from Murree eastwards. I have, however, never found it anywhere west of Naini Tal, and Evans tells me he did not get it in the Simla hills. It is not really common anywhere and seems to be very rare in the western part of its range. Flies just before the monsoon in Kumaon.

230. *Suastus gremius gremius*. Fabricius.

(Ev. I. 62 (1); Hesp. Ind. 66)

Common in many parts of the plains in India but does not seem to extend much into the Punjab and is definitely rare in the North-Western Himalayas. I have only taken a couple in Simla, both after the rains on flowers in my garden.

231. *Udaspes folus*. Cramer.

(Ev. I. 73 (1); Hesp. Ind. 176).

A larger and rather more striking insect than most of the Northern Hesperidae which does sometimes find its way into the ordinary collector's bag. It is not common in the hills and I have not seen it flying anywhere in the Simla Hills myself. I once noticed one in a soldier's collection made around Sabathu and it is probably more likely to be found in the lower country. It is not uncommon in the Oudh plains and in the outer hills in Kumaon, where I have also taken it as high up as 7,000 ft. Flies by day and in the evening round shrubs and moves very quickly so that a flash of white is all one sees.

232. *Notocrypta feisthamelii alysos*. Moore.

(Ev. I. 74 (4); Hesp. Ind. 177)

Another very rapid flier, darting from bush to bush, and terribly easy to lose sight of even after being glimpsed. It is to be found along the Himalayas from Murree eastwards but only becomes common from Kumaon. I have seen it only twice in the district—once at Barogh and once near Shogi station on the railway up. Flies summer and autumn.

Erlonota thrax thrax. Linnæus.

(Ev. I. 76 (1); Hesp. Ind. 155).

Has not yet been recorded from the district, but it is found from the Mussoorie Dun eastwards and there is just a chance it may appear in the country at the foot of the hills. It is rare except in the extreme north-east and Burma. The place to look for it would be in plantain groves.

* 233. *Hyarotis adrastus praba*. Moore.

(Ev. I. 82 (1); Hesp. Ind. 166).

Found from Kangra eastwards along the Himalayas, but is apparently very rare anywhere west of Kumaon. Neither Evans nor I ever got a specimen in the Simla Hills. Would, I think, be more likely to be found at low elevations.

Halpe moorei. Watson.

(Ev. I. 99 (26); Proc. Zool. Soc. 1893, p. 109).

The Halpes are a very large group of which one or more members are found in nearly every part of India except, perhaps, the extreme north-west. None have yet been recorded from anywhere in the Punjab; but *moorei* is one of the most wide-spread and common species and has been found in the Mussoorie hills. It may extend rarely into the Simla district.

* 234. *Actinor radians*. Moore.

(Ev. I. 102; Hesp. Ind. 105).

This species has a range from Chitral to Kumaon but is rare everywhere. Neither Evans nor I got it in the district. The only specimens I have ever taken were on a single occasion when I came across a small colony of them one March in a rocky nullah in the Sewalik Hills near Hardwar.

235. *Taractrocera danna*. Moore.

(Ev. I. 105 (1); Hesp. Ind. 88).

A common but rather elusive little beggar. It is such a small and quick-flying insect that it easily escapes the eye. I found it fairly plentiful on some of the open grassy slopes of the hills round Mahasu and on the Chail road in May and June, but never got it after the monsoon. It darts about the flowers in the grass but settles frequently.

* 236. *Taractrocera mævius flaccus*. Fabricius.

(Ev. I. 105 (2); Hesp. Ind. 86).

A butterfly of the plains found more or less generally over India. I have never seen it in the Simla Hills but it will probably occur—though not commonly—at lower elevations round Kalka.

237. *Padraona dara dara*. Kollar.

(Ev. I. 106 (7); Hesp. Ind. 78).

Another of the small, rapid-flying butterflies which escapes notice but is probably more common than one might judge from the number found in a catch. It darts about bushes and small trees in sunny surroundings and goes to flowers if there are any about. Flies May to October from 4,000 ft. upwards.

* 238. *Telicota pythias bambusae*. Moore.

(Ev. I. 108 (2); Hesp. Ind. 75).

Though recorded as an all India butterfly, this insect really belongs to the plains and lower hills, and I have never found it anywhere above 2,000 ft. or so. I have not caught it in the Simla district, but it must occur around Kalka, after the rains being the most likely time.

Augiades brahma. Moore.

(Ev. I. 109 (8); Hesp. Ind. 77).

Said to be not rare from Mussoorie eastwards and may possibly extend into the fringes of the district.

* 239. *Pamphila comma dimila*. Moore.

(Ev. I. (110); Hesp. Ind. 228).

A palearctic species which is found along the inner ranges of the Himalayas from Chitral to Kumaon. I know of no actual record from the Simla district; but it will very probably be found in the higher hills of the interior in the Chini neighbourhood.

240. *Baoris sinensis sinensis*. Mabille.

(Ev. I. 115 (5); Hesp. Ind. 38).

I have not taken this species in Simla myself, but Evans tells me it is not rare especially around Mahasu. It is a quick-flying insect, and flits about flowering shrubs in the open and is noticeable when present, so it should not ordinarily be missed. Flies both summer and autumn elsewhere.

* 241. *Baoris mathias mathias*. Fabricius.

(Ev. I. 115 (6) ; Hesp. Ind. 35).

A very common insect of the plains. Neither Evans nor I got it in Simla but it is certain to occur at lower elevations and should be looked for among the shrubs and small trees which clothe the low hills near Kalka. It is on the wing at all times except the very cold months.

242. *Baoris discreta himalaya*. Evans.

(Ev. I. 115 (20) ; Rev. Oriental Hesp. p. 282).

Though not usually rare where found, I have not seen many in the Simla region. Like most of the other species of *Baoris*, it frequents shrubs and flowers and flies most of the year. I fancy that anyone who keeps a sharp look-out for butterflies of the genus will find it is more common than might be imagined.

243. *Baoris guttatus guttatus*. Bremer and Grey.

(Ev. I. 115 (28) ; 1 Hesp. Ind. 41).

Baoris guttatus bada. Moore.

Two very slightly differentiated races of the common *guttatus*, the former being the hill variety found above about 2,000 ft. while *bada* keeps to the plains. In Simla, *guttatus* does not seem to fly much before the rains, but is common after. It flits like a little brown speck about and across gardens but often settles on flowers and can easily be taken. *Bada* will probably be found round Kalka and Ambala.

244. *Baoris zelleri colaca*. Moore.

(Ev. I. 115 (30) ; Hesp. Ind. 43).

Also common in the plains generally, but does not seem to extend much into the hills. I have taken only one specimen in Simla, but it should be more prolific in the country at the foot of hills. Its habits and seasons are like the preceding species.

245. *Baoris bevani bevani*. Moore.

(Ev. I. 115 (31) ; Hesp. Ind. 44).

Also of similar habits and seasons, but far more frequently met with in the hills. I got several in my garden in October one year.

* 246. *Gegenes nostradamus*. Fabricius.

(Ev. I. 116 ; Hesp. Ind. 39).

A common but, judging by the few one gets hold of, a very elusive little butterfly. Neither Evans nor I ever caught any in and around Simla ; but it is found all over the Punjab plains and I have it from below Dalhousie and one from Almora so that it will probably be found in the low valleys.

THE STUDY OF INDIAN BIRDS.

BY

HUGH WHISTLER, F.Z.S., M.B.O.U.

PART IX.

(With a plate and a text-figure.)

(Continued from page 324 of this volume.)

THE REPRODUCTION OF BIRDS.

The Egg.

There are many aspects to the study and interest of Birds and their lives ; but it is quite safe to say that by far the most popular is that of their eggs. There is something peculiarly attractive about an egg itself. It is so clean and neat an object. It is often surprisingly beautiful, even apart from the perfect setting of its nest. To search for nests is to combine the pleasures of nature and of sport. A day's bird-nesting is a day spent in the open air. The careful search and the patient watching necessary for more than a mere occasional success brings one in touch with every aspect of nature. Exercise and pleasure and interest are all combined. Whilst the attainment of the specially coveted eggs may imply all the care and skill, the extended expeditions and the actual dangers of which the sportsmen's trophies too are only the symbol and memento.

The egg appeals also to the orderly mind of the born collector. A collection of eggs like a collection of stamps affords an outlet for all his instincts of neatness and acquisition. He is able to blow the egg neatly, label it neatly and arrange it with loving care and precision. The amassing of a large number is within the means of the most moderate income. The infinite varieties found in a single species provide an excuse alike for wholesale depredations and extreme specialisation.

It is therefore eminently pardonable, to use Professor Newton's words, for the victims of this devotion to dignify their passion by the learned name of 'Oology', and to bespeak for it the claims of a science. Though there can be little doubt that the study of Oology has not conferred benefits on scientific Ornithology at all commensurate with the number of its votaries and the time which they have spent on it.

However that may be, we are here concerned with the egg chiefly as an item in the story of the reproduction of birds.

We have already seen that one of the characteristics which Birds retain from their reptilian ancestry is the fact that they are oviparous, that is, produce their young through the medium of eggs. The eggs of many present-day reptiles are essentially the same as the eggs of birds, though the majority of them have not attained to quite the same degree of development in the formation of hard shells. The number of eggs laid in the clutch has with development decreased amongst birds.

Before describing the egg itself it is desirable to describe briefly the reproductive organs of the parents and give a brief summary of the development of the egg.

In both sexes of a bird the reproductive organs are situated against the upper wall of the abdominal cavity at the anterior end of the pelvis. This corresponds roughly to what in ourselves we should describe as the small of the back or the region of the kidneys.

In both sexes the organs consist of paired germ-producing glands and their efferent ducts, but it will be most convenient to consider the sexes separately.

In the male the testes are a pair of whitish-yellow glands, oval, globular or occasionally kidney-shaped or vermiform which lie at the anterior end of the kidneys. Within each testis there is a multitudinous multiplication of germ-cells from which the spermatazoa pass into a convoluted body known as the epididymis and thence into the main duct the *vas deferens*,¹ a narrow tube which extends along the inner wall of the abdominal cavity to the cloaca or vent. The ends of the two *vasa deferentia* are often slightly dilated to form seminal vesicles, that is store-chambers for the spermatazoa. The *vas deferens* is typically of a slightly zigzag character.

These parts of the male reproductive system should be clear after reference to the illustration (Fig 1). It must be understood that, except in the Ratitæ and certain other forms such as the Coraciidæ and some of the ducks, the male bird has no penis. The end of the cloaca has to act for it.

During the breeding season, these organs, which at other times are very minute in size, become greatly enlarged. The testes in the House-Sparrow (*Passer domesticus*), for instance, grows from the size of a minute pin's head to that of a ground-nut, temporarily even displacing the usual arrangement of the intestine, liver and stomach. The two testes are then often rather different in size, and also sometimes in shape. The *vasa deferentia*, also increase considerably in length, the extra length forming a closely convoluted mass round the entrance to the cloaca, causing it to protrude and in some dried skins to assume a character and shape which lead to much misunderstanding.

In the female bird a pair of ovaries are developed in the same position as the testes of the male. With rare exceptions, however, the right ovary dwindles and disappears at an early stage of growth. The known exceptions are chiefly amongst the birds of prey and an example of the presence of a double set of ovaries will be easily found by any one who troubles to dissect the female of the Indian Shikra (*Astur badius*). It is not known why the right ovary should disappear in most species, or why it should be retained in the few exceptions. It does not appear to function and even when it remains the right oviduct remains quite vestigial.

The ovary consists of a mass of embryonic eggs, several hundred in number which may be described as presenting the appearance of a minute cluster of grapes.

¹ Care must be taken to distinguish the *vas deferens* from the ureter which lies parallel with it.

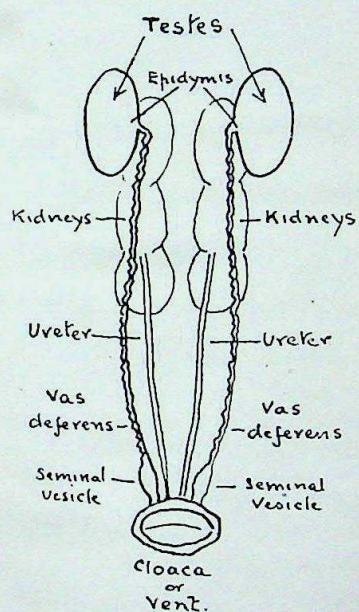


Fig 1
MALE ORGANS OF
A BIRD.
(enlarged in the
breeding season).

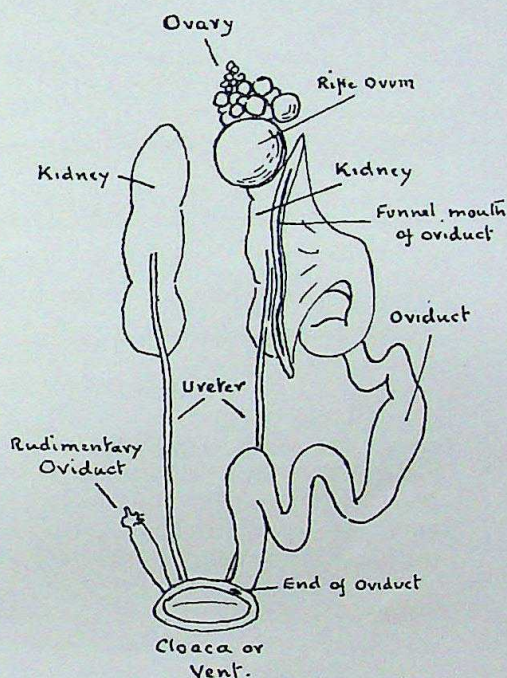


Fig 2
FEMALE ORGANS
OF A
BIRD.
(enlarged in the
breeding season).

The oviduct is a gut-like tube which passes from the neighbourhood of the ovary down to the left side of the cloaca. Its upper end is wide and trumpet-shaped, free in structure but in position pressed against the ovary. The lower end enters the cloaca close to its external entrance. (Fig. 2).

As in the male the female organs increase tremendously in size with the breeding season. The ovary which at other times may appear to the naked eye as a mere indistinct film with no granular structure becomes a big bunch of eggs in every stage of development from a microscopic object to a full-grown ripe ovum with a large amount of yolk. So with the oviduct. In the common Fowl, according to Gadow, the oviduct is normally six or seven inches long and scarcely a line wide; but at the time of laying eggs it becomes more than two feet in length and nearly half an inch in width. Its volume thus increases about 50 times, and this is an annual change with all wild species.

It is clear from the fact that both male and female organs lie dormant for part of the year and then exhibit a huge seasonal enlargement; that birds cannot indulge in coition and breed just when the fancy takes them. Their breeding is necessarily a seasonal affair, dependant on the development of the organs which must arise from either external or rhythmic stimulus. This stimulus, obscure in origin though it may appear to be, acts so far as we know on each sex separately.

If an observer in the Kashmir valley in spring makes a systematic collection of a series of starlings (*Sturnus v. humei*) which have returned there for breeding he will find that the males have the testes fully developed at the time when the female ovaries only show a slight enlargement.

At first thought one is inclined to think that this implies that stimulus from the male awakens the female. It is not so however. The male and female organs both awaken in response to a common external stimulus. The male however develops the more quickly because his function is required in the early stages of the eggs, before they have enlarged enough to bring the ovary to its maximum.

Being now, I hope, familiar on broad lines with the reproductive organs of both sexes we can proceed to consider the process leading up to the production of the perfect egg.

As any observer may see for himself the union of a pair of birds—insemination as it should properly be called—is a very brief affair, a matter of seconds usually. The purpose is of course the transference of the spermatazoa from the male to the female, but fertilization cannot be said to have taken place until the spermatozoa meet the ova themselves.

I am not competent to describe the minute and obscure processes involved in the reproduction of the young bird; but put briefly and generally, it is something like this.

The ovum (the female germ) and the spermatozoon (the male germ) each contain nuclear rods known as chromosomes. These are the vehicles of the hereditary equipment of the bird and they are set aside in the earliest stage of embryonic development, so that one

may almost say that the 'hereditary formula' which makes the bird passes direct from generation to generation independent of the life history of the individuals. (It is on this fact that all the controversies as to the inheritance of hereditary and acquired characteristics hang.) In the ovum (while still in the ovary) and in the spermatozoon, these chromosomes divide as part of their normal maturation, and fertilization consists of the reunion of the chromosomes, half from the male germ and half from the female germ, to form again the complete unity which is then gradually clothed anew in a fleshly envelope, a fresh unit or segment of the generations which are the vehicle for the 'hereditary formula'. The mother body no doubt provides much of the raw material which forms the envelope, but it is clear from the fact that each parent provides half the chromosomes, how intimately and how subtly the young creature has exactly half its essential self from each parent.

The spermatozoa of birds are not similar in appearance for all species. They are of course exceedingly minute—it is said that a hundred can swim about in a drop of fluid suspended by the head of a pin—and they consist of three parts, a head, a centre and a long tail. The head contains the chromosomes. The centre contains a minute body called the centrosome. The tail is purely locomotive in purpose. Its moves drive the head along. It is in the nature of typical spermatozoa to move against a current. After insemination the spermatozoa left by the male in the cloaca of the female move, driven by their long tails, up the slight downward current of secretion in the female oviduct until they meet the ova. This may apparently be either in the mouth of the oviduct or in the ovary itself.

To return for the moment to the question of the ova. With the beginning of the breeding season the immature ova on the surface of the ovary start to accumulate yolk, that is nutritive fatty material which is brought to them by the blood and the lymph. They start irregularly so that many different sizes of immature eggs may be seen in the ovary. Then as an egg ripens it bursts from the capsule in which it grew and is caught by the trumpet-shaped mouth of the oviduct. At this stage either before, or generally after, the bursting of the capsule the egg is fertilized by the spermatozoa. If fertilization does not take place the egg may go through its normal development and be laid, all to no purpose. Or undeveloped and unfertilized eggs may be reabsorbed into the parent tissues and the ovary dwindles again until the new season again ripens the ova.

When the spermatozoon reaches the ovum its head pierces the envelope of the ovum and carries within it the chromosomes and the centrosome. The locomotor tail, having accomplished its purpose, is shed without as waste matter. The centrosome divides and becomes the centres of great protoplasmic activity, in other words become the stimulus to the growth of the embryo. The chromosomes, half of the male complement, unite with the present half of the female complement. The total is once more complete and the 'hereditary formula' (as I have called it to express in one both an idea and an entity) is fulfilled again ready to hand on through the next generation. Once a spermatozoon has entered an ovum,

the outer surface of the ovum changes in character so that it becomes non-receptive to the entry of fresh spermatozoa. If this change is delayed, fresh spermatozoa may enter, and in some cases lead to the birth of monstrosities, by disturbing the work of the original centrosome.

We will now follow the history of the fertilized ovum. It burst from its capsule, we have seen, because of the pressure exerted by the continued accumulation of yolk and consequent increase in size. Occasionally the liberated egg may miss the oviduct and fall into the abdominal cavity. In that case it is usually reabsorbed by the peritoneal surfaces, though occasionally, and doubtless only if the bird is not in vigorous condition, a fatal disturbance is caused to the system. Normally however the egg is caught up by the trumpet-shaped mouth of the oviduct whose position with reference to the ovary generally ensures success.

In the oviduct the ovum or germ-cell becomes the egg as we know it. It is not necessary here to describe the oviduct or its processes in great detail. Suffice it to say that as the ovum passes slowly downwards, it is surrounded by various instalments of albumen (white of egg): it is surrounded by a shell-membrane and a calcareous shell; the shell is usually stained with pigments before it is finally set; and the manner of the deposition of these pigments, that is the markings of the perfect egg, afford some hint as to the order and time when they are laid on to the shell. The fact that the egg travels downwards with the broad end first explains why most eggs have the majority of their markings at that end and why a cap or a zone is so common a type of marking. Finally the perfect egg is expelled from the oviduct and through the vent and is henceforth separate from the body of the parent.

We are accustomed to attach a great deal of importance to the actual laying of the egg, and naturally so. At this point the egg appears in human ken. At this point it becomes of importance to the human being, whether as a matter of food or of interest. But strictly speaking, this stage is not of the same importance to the embryo itself. We have got to hold to the idea of one straight line of development starting with the maturation of the ovum in the oviduct and leading through an infinity of phases to the adult bird. The mysterious rhythm of life prepares the ovum ready for this line of development. The impetus to the start is furnished by the spermatozoon. Without it the matured ovum fades away again. With it the embryo unfolds like a plant from the seed. At the start it is housed in the ovary, then in the oviduct, then in the shelled egg, then in the nest; the final stages to maturity are passed as a complete bird. But we have to remember that the stage which is passed by the embryo in the shelled egg is no whit the more important to the embryo from the fact that its coffer then becomes, from utilitarian or æsthetic uses, of interest to the human being. To emphasize this, we have only to remember the case of the snakes and lizards. Some are oviparous and others viviparous, that is to say, the egg case may break within or without the body of the parent. Their whole clutch is often laid at one time, or at any rate in batches,

We attach a false importance to the egg, we are apt to consider it as the starting point of the embryo, for one very good reason. At this point nature usually applies the brake, and we witness the restarting.

Each egg is laid after an interval of 24 hours on the average. Occasionally the period is shorter. In some species the interval is 48 hours. The clutch of eggs is often quite large, say 12 or 14 eggs. The growth of a young bird is in its early stages particularly rapid. It is easy to see therefore that if each embryo continued its progress unbroken the safety of part of the brood would be greatly endangered. In cases of a large clutch—the long-tailed Tits of the genus *Ægithalus* for instance—some of the eggs would be still unhatched whilst the young from the earlier eggs would be almost ready to fly. The labour to the parents would be greatly increased and either the oldest or the youngest members of the brood would of certainty suffer and probably be lost.

Originally in the ancestral bird no doubt there was no halt in the development. The egg was laid in the herbage and rotting vegetation of the steaming primeval world and the incubation of the embryo proceeded unchecked by the transfer from the maternal body to the outer world. The same thing continues to-day, as we have seen, in the case of the Megapodes who immediately bury their egg deep in the mound of sand and vegetation and so retain its initial warmth.

The case of the Megapodes is however exceptional. The general rule is for the egg to be laid in the open and so experience a definite drop in temperature from the body heat of the mother. This drop in temperature retards the development of the embryo, just as all the functions of a hibernating butterfly or dormouse remain in abeyance during a fall in the temperature. If the drop is too low or too long the embryo must perish. A few families such as the Owls (*Strigidae*) and the Herons and Bitterns (*Ardeidae*) are accustomed to start to incubate with the laying of the first egg. The result is that in these cases there is no gap in the development of each embryo. The young in the nest are found in regular gradations of size, and their habits are such that no particular injury is inflicted on the broods, or trouble given to the parents by the different ages of the young. In these forms the character of the food and the comparative ease with which it is obtained, probably contributes to success.

The vast majority of birds, however, pay little attention to the nest or eggs until the clutch is complete. The newly-laid egg cools to the air-temperature. The embryo becomes torpid and all development is arrested. With the completion of the clutch the parent starts to incubate eggs in which the embryonic development has all been arrested at the same stage. The resulting nestlings all hatch about the same time. When they fledge and leave the nest about the same time. When they fledge and leave the vicinity of the nest, the parent is free to continue with them and often remains with them for a considerable period.

It may be of interest to describe the structure of the newly-laid egg (Fig. 3). Popularly we talk of the yolk, the white, the inner

skin and the shell of an egg. These must be considered in greater detail.

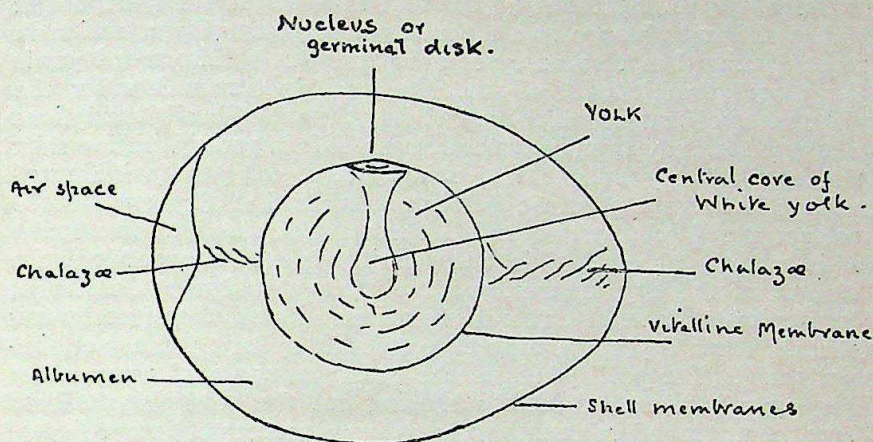


Fig. 1. Sketch of egg with shell removed.

The yolk consists of two different textures, known as 'white yolk' and 'yellow yolk' (though both of them are really yellow in colour). The white yolk contains a higher percentage of water. Reference to the figure will show that there is a central core of white yolk, funnel-shaped, and surrounded by yellow yolk in which there are alternating layers of the white yolk. On the top of the disk of the funnel core lies the nucleus or germinal disk of blastoderm out of which the embryo is to be developed. It is to be remarked that the yolk as a whole turns about within the egg so as to keep the germinal disk uppermost, whichever side the egg is lying on, so that it is nearest to the warmth of the incubating mother. This explains why the good poultry-keeper turns daily the eggs which are being kept for a setting, in order to insure that the yolk should retain its mobility against the time of need. The yolk with the germinal disk is contained within a vitelline membrane which is really the cell-wall of the original ovum dilated to contain the addition of the yolk which it received in the ovary.

The white or albumen is added in the oviduct. It consists of alternating dense and watery layers which give it a spiral arrangement. Some of the denser layers near the vitelline membrane extend as twisted cords (chalazæ) towards the two poles of the egg. They do not quite reach the outer layer of the white though the chord at the pointed end ultimately becomes somewhat superficially attached to the lining membrane of the shell. These chalazæ are elastic supports for the yolk and suspend it in position. The complete egg thus constituted is enclosed in the shell-membrane which consists of an inner and outer layer, both of which remain permanently in close apposition over the greater part of the egg and adhere to the shell. At the broad end they tend to separate and develop an air-chamber between them. This air-chamber does

not exist in a perfectly fresh egg but is produced and increases as the bulk of albumen decreases by evaporation. This air-chamber explains why an incubated egg floats. The shell is finally deposited on the shell-membrane as a mamillary and porous layer, which in most species has also an outer cuticular layer. This outer layer is the most variable part of the shell and is responsible for the differences of texture which we find duly chronicled in all descriptions of eggs. It is apparently structureless; if it is poor in calcine salts the egg is very smooth and shiny. If it is greatly infiltrated with calcareous matter we get the rough and chalky eggs of the cormorants (*Phalacrocorax*) and Grebes (*Podiceps*). In some forms it is entirely absent. This outer cuticle is spread over the entire surface of the egg, extending unbroken over and into the pits (or surface ends of the air-canals in the main shell) and therefore closing them. When dry, the cuticle is permeable by air, when wet, impermeable. The poultry-keeper who uses 'water-glass' to preserve his eggs is therefore merely keeping out the air by a sterilized layer of water and so arresting the ordinary process of decay.

The actual colour of the egg is produced by pigment-corpuscles,¹ which may be deposited in various levels of the shell. The pigments are deposited by the oviduct during the formation of the shell and cuticle and they may be deposited according to species in any or every strata. The colour in the innermost layer may not be visible until the blown shell is held up to the light. As the colour and pattern of the egg are deposited by secretions from the oviduct, it is not curious that there is distinct resemblance between the eggs of one clutch and the various clutches laid by an individual bird. The poorly-marked and pale egg so often found in a clutch is usually either the first egg (before the pigment secretions are fully working) or the last (when they are becoming exhausted).

I do not propose to discuss the varied colours of eggs in detail. These my readers can supply from their own experience. But it is well perhaps to emphasize a few general points. Firstly, there is no connection at all between the colour of a bird and of the egg which it lays. Secondly, there is very little taxonomic significance in the colours and patterns of eggs. We may attribute a certain type of egg to a particular family and then find that such a description might almost equally apply to the eggs of a totally different group.

I have already pointed out that it is probable that all eggs are derived from an original white or pigmentless egg similar to those laid by some reptiles to-day; and I think it is correct to consider that with eggs and nestlings there is a great deal to be said for the theory of protective colouration. With eggs it would have had two active stimulants. First of all, as we have seen, a white egg is a most conspicuous object in the open and colouration and markings must undoubtedly tend to an increase of safety. Whilst at the same time we must remember that light in excess is inimical to protoplasm. Pigment in the shell must therefore also be of importance in protecting the germinal disk from direct light.

¹ This subject has not yet been fully investigated and very little is really known about it.

It is customary to point to the fact that most hole-breeding species lay white eggs as proof that the original egg was white. It is certainly an indirect proof, but we must also remember that as much development has gone to the making of the highly glazed eggs of the Woodpeckers and Bec-eaters as to the protectively-coloured eggs of the Nightjars and Sandgrouse. In such cases the need has perhaps been conspicuousness, so that the parent bird entering the hole may readily distinguish the eggs and so avoid accidents.

There are a few points of interest.

Abnormal eggs are common and they are most usual in domesticated birds, especially fowls, where unsatisfactory conditions of food and environment or over-production of eggs and consequent strain affects the normal action of the oviduct. A 'soft-shelled' egg is due usually to lack of sufficient calcareous matter. A dwarf egg is due to various causes. The ovum may have been liberated from the ovary prematurely and so have not received its proper allowance of yolk. There may be some pathological condition of the oviduct which means that the dwarf egg is its last product. In other cases a blob of albumen without an ovum, a blood clot or some foreign body passes through the oviduct stimulating its functions and resulting in the production of a miniature but functionless egg.

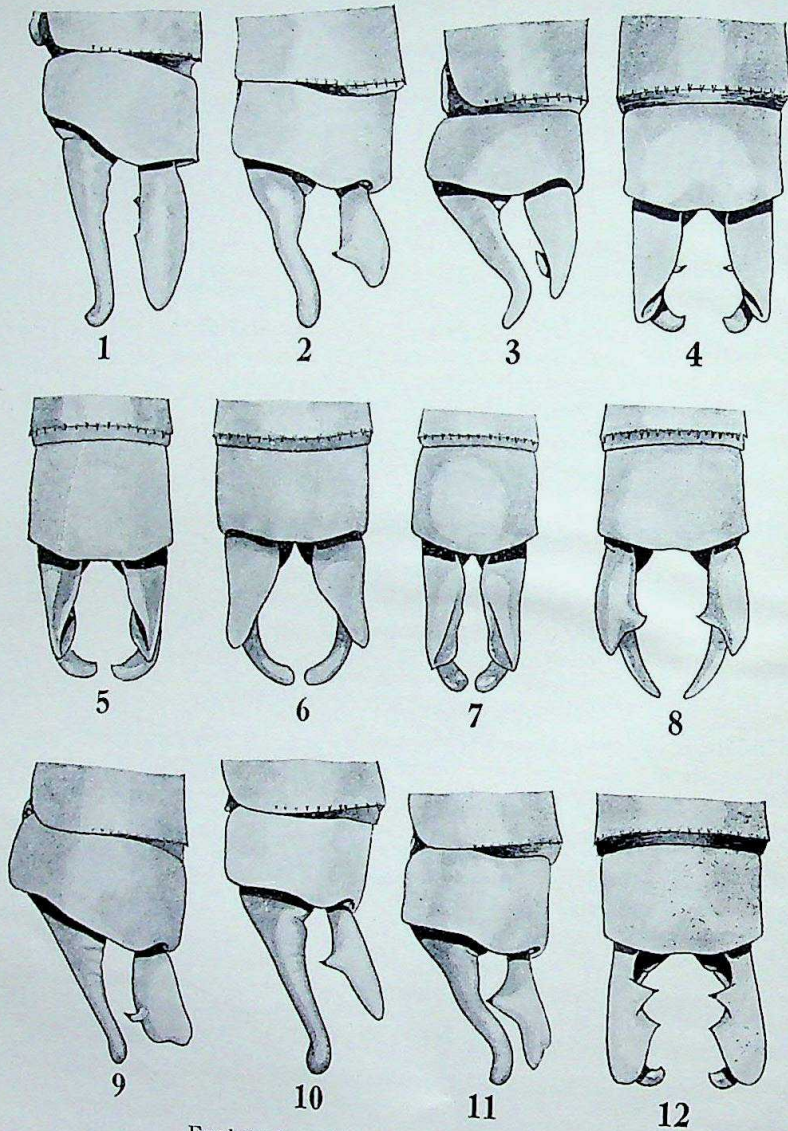
Double- and very rarely triple-yolked eggs occur. A double-yolked egg is due to the liberation of two ova into the oviduct from the ovary without the usual interval between. Different varieties of arrangement of such double-yolked eggs are due to the levels within the oviduct at which the ova coincide. Triple-yolked eggs are of course similarly caused. Twins are known to have hatched from double-yolked eggs.

We may remark here on the explanation of the increase in the comb of domesticated hens at the time of egg-laying, as a similar phenomenon must occur in many wild birds. The increase of the comb is due to a fatty infiltration of the central connective tissue core of the comb. When this fat is decreased, the comb again dwindles. At egg-laying periods the blood is charged with fatty material which provides the yolk for the ova. The excess of this is deposited in the comb and probably also has some connection with the change of colour of the soft parts of many species during the breeding season.

Mention must also be made of the unconscious power which many birds undoubtedly have of regulating the number of eggs laid. Not much is known about this but the common Wryneck (*Jynx torquilla*) which normally lays some 6 to 10 eggs has in England been induced to lay upwards of 40 eggs. This is done by the simple method of abstracting an egg from the nest daily during the laying period so that the clutch is never completed. These extra eggs would normally never have been laid. We believe that the converse also obtains, that eggs which normally would have been laid on a certain date are delayed or even suppressed when the destruction of the nest, abnormal weather or other circumstances render it desirable. The fact is certainly well-known to the poultry-farmer. Runner-ducks at the full height of daily laying immediately stop in response to some sudden change in their surroundings.

Connected with the egg is the so-called 'incubation patch' on the parent birds.

The incubation patch is a bare patch of skin, often of considerable extent, on the under surface of the incubating bird. It reaches its greatest development in the female but is also found to a lesser extent in those males which share the work of incubation. One is apt to think loosely that the patch is due to the attrition of the feathers from contact with the eggs or that they are plucked off by the parent. This however is not so. The patch often starts before the eggs are actually laid and it is due to a local moult which is induced by a physiological factor. This is a very definite transformation locally of the skin and blood vessels. The blood vessels increase whilst the skin becomes loose-meshed and watered from an absence of the fatty layer and an escape of the blood serum from the vessels into the tissues. The result is a local inflammation which concentrates body heat on the eggs. In most species the patch is a single large central one, but in the Waders there are two lateral patches. It is noteworthy that that aberrant Wader, the Crab-Plover (*Dromas ardeola*) has these two lateral patches although it only lays a single egg.



Explanation of Plate.

Anal appendages of

1. *Coelliccia fraseri* seen from the left side.
2. *Coelliccia poungyi*, same view.
3. *Coelliccia loogali*, same view.
4. *Coelliccia chromothorax*, dorsal view.
5. *Coelliccia loringæ*, dorsal view.
6. *Coelliccia renifera*, dorsal view.
7. *Coelliccia poungyi* dorsal view.
8. *Coelliccia loogali*, dorsal view.
9. *Coelliccia chromothorax*, seen from the left side.
10. *Coelliccia renifera*, seen from the left side.
11. *Coelliccia didyma*, seen from the left side.
12. *Coelliccia fraseri*, dorsal view.

INDIAN DRAGONFLIES

BY

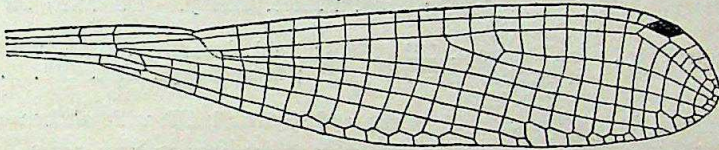
F. C. FRASER, LT.-COL., I.M.S., F.E.S.

Part XXXIX.

(With 1 plate and 1 text-figure.)

(Continued from page 341 of Volume XXXIV.)

Sub-family : PLATYCNEMINAE.



Forewing of *Coellicia membranipes* (Ramb) to illustrate the venation of the Platycneminae.

Dragonflies of small size, coloured black marked with blue or bright chrome yellow, or red or chrome yellow marked with black, or black marked with red, never metallic: resting with wings closed over dorsum; wings narrow, rounded at apices, always hyaline: the nervure *Ac* situated about midway between the levels of the two antenodal nervures or rather nearer the level of the distal one: no accessory basal postcostal nervures ever present: petiolation beginning at or slightly distad the level of *Ac*; the nervure *Ab* always present and continuous with the nervure *IA*, which latter extends to the middle or beyond the middle of wings; *Cu* well developed and extending a short distance beyond the end of *IA*; discoidal cell variable but always elongate, the distal end slightly bevelled or squared, the costal side of discoidal cell shorter than or of the same length as the posterior; sectors of arc arising from lower end of arc, divergent from their origins; individual cells mostly four-sided; origin of *Riv + v* variable in the genera and species, either arising before, at or more or less distad the level of the oblique nervure descending from the node; pterostigma diamond-shaped, rather longer than broad, usually braced; no intercalated sectors present except *IRii*.

Abdomen of moderate length, slender or moderately robust, falling well short of twice the length of hindwing, the segments 8, 9, and 10 becoming progressively shorter in all genera and species; anal appendages of male showing great variation both in the genera and individual species, but very homogeneous in some of the genera such as *Coellicia* and *Calicnemis*. Vulvar scales robust but not as conspicuous as in the *Platystictinæ*; penile organ very variable but usually with the end curling up over the stem and more or less branched at its termination.

Larvæ known of only a few species and very variable; breeding in streams or swamps and usually in heavy virgin jungle.

Distribution.—Throughout the tropics of the Old World, and, for at least one genus, the temperate zones of Europe and Asia. Within our limits, throughout India, Ceylon and Burma, usually in montane and submontane tracts, but all genera except *Copera* confined to N.-E. India and Burma. *Platycnemis* however occurs sparingly in the North and North-west of India. Five genera occur within our limits.

Key to the Indian genera of *Platycneminae*.

- | | | | |
|----|---|---|----------------------|
| 1. | { | Costal side of discoidal cell at least one-fifth shorter than the posterior, usually more than this ... | 2. |
| | { | Costal and posterior sides of discoidal cell nearly equal in length ... | <i>Copera</i> . |
| 2. | { | The nervure <i>Ab</i> arising at the level of <i>Ac</i> ... | <i>Coeliccia</i> . |
| | { | The nervure <i>Ab</i> arising proximad of the level of <i>Ac</i> ... | 3. |
| | { | Four cells between the discoidal cell and the oblique nervure descending from the node ... | <i>Indocnemis</i> . |
| 3. | { | Three cells between the discoidal cell and the oblique nervure descending from the node ... | <i>Calicnemis</i> . |
| | { | Only two cells between the discoidal cell and the oblique nervure descending from the node ... | <i>Platycnemis</i> . |

Genus COELICCIA Kirby (1890).

Trichocnemis Selys, Sagra, Hist. Cuba, Ins. p. 464 (1857); Id. Bull. Acad. Belg. (2) xvi. p. 155 (1863); Id. Mem. Cour. xxxviii p. 114, (1886); Laid. Fascic. Malay. (*Odonata*) Part ii, pp. 2-7 (1907).

Coeliccia Kirby, Cat. Odon. p. 128 (1890); Laid. Rec. Ind. Mus. vol. xiii, pp. 322, 325, 331-333 (1916); Ris. Suppl. Ent. No. 1. pp. 60-62, (1912).

Zygopterous dragonflies of medium size and slender build with abdomen less than twice the length of hindwings; coloured black marked with blue, yellow or bright chrome yellow. Wings hyaline, moderately narrow, rounded at apices, never falcate, with a moderately long petiole; discoidal cell elongate, costal side about four-fifths or slightly less than four-fifths the length of posterior side, distal side at least half as long again as basal and very oblique so that the cell is acutely pointed at its lower distal angle; sectors of arc slightly separate at origin, arising from lower end of arc, divergent from origin; no accessory basal postcostal nervure present; the nervure *Ac* situated at a level slightly nearer the distal antenodal nervure; *Ab* always present and complete, continued on as *IA*, which latter extends for nearly three-fourths the length of wings; petiolation beginning slightly proximal to *Ac*; *Cuii* extending a short distance beyond the end of *IA*, 20 cells or more in length; *Riv + v* arising a little proximal to level of node, *IRiii* a little distad but the position of these two latter very variable in species; pterostigma small, its sides nearly equal, oblique and diamond-shaped, poorly braced; cells of wings mainly quadrangular; 2 or 3 cells between the discoidal cell and nervure descending from the node.

Head narrow; eyes smaller than in species of *Platysticta*; occiput simple; prothorax with the posterior lobe rounded and simple in the male, notched or armed with elongate spines in the female; abdomen cylindrical, slim, broadened at extreme base and gradually broadening from segment 7 to the end, about one-third longer than the wings; anal appendages variable in the species but inclined to be rather homogeneous, superiors usually broad at base, acute at apex and furnished with an inner subapical spine, inferiors longer than superiors, broad at base, abruptly tapered and subcylindrical, slightly sinuous, subacute or acute at apex. Genitalia.—lamina narrowly but deeply cleft; hamules broad quadrate plates meeting broadly across the genital pit; penis deeply cleft, bifid or branched; lobe pyriform, short, with a shallow longitudinal groove running its whole length; vulvar scales robust, stout, extending slightly beyond end of abdomen.

Distribution.—N.E. India, Burma, Malaysia, Indo-China, Formosa, Philippines, Sondaic Archipelago and Borneo. Only nine species found within Indian limits, of which five occur in Assam, and the others in Burma. Genotype.—*C. membranipes* (Ramb.).

Laidlaw has divided the genus up into three groups according to the relative positions of *Riv + v* and *IRiii* to the subnode. In the 1st group, *IRiii* arises at the subnode, *Riv + v* proximal to it; in the 2nd, *IRiii* arises distal and *Riv + v* proximal to it; in the 3rd, *IRiii* arises distal to the subnode and *Riv + v* from it. Most Indian species belong to the first and second groups.

INDIAN DRAGONFLIES

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Key to Indian species of genus *Coelliccia*.

- | | | | | |
|----|---|-----|-----|-----------------------------|
| | Dorsum of thorax wholly blue | ... | ... | <i>C. poungyi</i> Fras. |
| | Dorsum of thorax wholly golden yellow | ... | ... | <i>C. chromothorax</i> |
| | Dorsum of thorax with a single pair of oval | ... | ... | (Selys). |
| 1. | pale blue spots | ... | ... | <i>C. bimaculata</i> Laid. |
| | Dorsum of thorax with two pairs of pale blue spots | ... | ... | 2. |
| | Dorsum of thorax with a pair of antehumeral stripes | ... | ... | 3. |
| | Dorsum of thorax pale blue for the lower half | ... | ... | <i>C. renifera</i> (Selys). |
| | Lower pair of spots simple, pyriform; segment 10 | ... | ... | <i>C. didyma</i> (Selys). |
| 2. | and the basal two-thirds of segment 9 pale blue | ... | ... | |
| | Lower pair of spots broad and branching into two | ... | ... | |
| | above; segment 10 blue marked broadly with | ... | ... | |
| | black at apical border; segment 9 wholly blue; | ... | ... | |
| | segment 8 with its apical half blue | ... | ... | <i>C. loringae</i> Laid. |
| | Antehumeral stripes lying nearer the humeral suture | ... | ... | |
| 3. | than middorsal carina | ... | ... | 4. |
| | Antehumeral stripes lying closely opposed to the | ... | ... | |
| | middorsal carina | ... | ... | <i>C. fraseri</i> Laid. |
| | Posterior lobe of prothorax of female simple | ... | ... | <i>C. loogali</i> Laid. |
| 4. | Posterior lobe of prothorax of female prolonged | ... | ... | |
| | and deeply and broadly notched, the corners of | ... | ... | |
| | the notch prolonged into long recurved horns as | ... | ... | |
| | seen in profile | ... | ... | <i>C. vacca</i> Laid. |

Coelliccia bimaculata Laid.

Coelliccia bimaculata Laid. Rec. Ind. Mus. vol. viii, p. 341, pl. xvi, fig. 1 (1914); Id. ibid. vol. xiii, pp. 335, 336 (1917); Id. MS (1931).

Male. Abdomen 36 mm. Hindwing 22 mm.

Head,—labium pale yellow; labrum black; anteclypeus, genæ and the bases of mandibles partly blue; postclypeus, frons and vertex black, the latter traversed at the level of ocelli by a broken pale blue stripe; occiput with pale yellowish pyriform postocular spots.

Prothorax black, the sides palest blue or creamy white.

Thorax black on dorsum, palest blue laterally, the former with a pair of oval pale blue spots lying in close apposition to the anterior half of the middorsal carina; a narrow oblique black stripe on each side bordering the mesepimeron anteriorly; beneath creamy white.

Legs palest yellow, femora with two black stripes, tibiae black on flexor surface only, joints and ciliae black.

Wings hyaline; pterostigma blackish brown framed palely in brown, its proximal border very oblique, covering 1 cell; *Riv* + *v* arising proximal to the subnode, *1Riii* at the subnode; 18 to 20 postnodal nervures in forewings, 17 to 18 in the hind.

Abdomen dark reddish brown on dorsum deepening to black at apical end of segments and on dorsum of segment 2 and segments 7 to 10. All segments pale yellow laterally, this colour extending dorsalwards on 3 to 6 so as to form paired spots.

Anal appendages creamy white; superiors triangular as seen from above, deeply excavated within, the inner border ending in a minute black point. Inferiors slightly longer than superiors which are themselves slightly longer than segment 10, slender, curling in at apices forcipate-like and also ending in a minute black point at apex.

Penis with a prominent terminal lobe, the apex bifid and ending in a pair of long whip-like processes.

Female. Abdomen 35 mm. Hindwing 23 mm.

Very similar to the male but the blue replaced by creamy white except the facial markings and lower half of eyes which are blue. Prothorax with black posterior and anterior lobes, these two areas confluent by a fine middorsal black line on middle lobe; posterior lobe with the middle of hinder border prolonged into a small tongue-like process on either side of which is a minute lobe. (This lobe evenly convex along the hinder border in the male.)

Dorsal thoracic markings narrow stripes lying close to middorsal carina and prolonged and narrowing as far as the antealar sinus very much as in *C. fraseri*. Segment 8 of abdomen with its apical two-thirds palest yellow, or, in teneralis, segments 8 to 10 entirely creamy white. Anal appendages and vulvar scales pale yellow.

Distribution.—Several males and females from Tura, Garo Hills, Assam. Type, an incomplete male in the Indian Museum, taken at an altitude of 1,500 ft. June and July. Distinguished from other species by the two oval spots on thoracic dorsum and by the pale undersurface of thorax.

Coelliccia vacca Laid Rec. Ind. Mus. MSS. (1931).

Female. (Male unknown) Abdomen 36 mm. Hindwing 25 mm.

Head,—labium pale yellow, labrum black, anteclypeus, genæ and bases of mandibles pale blue, rest of head black with a chain of four small spots across the ocellar space and a pyriform postocular spot on each side of occiput, eyes black above, greenish for the lower half.

Prothorax with anterior and posterior lobes black, this dark area connected by a broad median black stripe on middle lobe, the sides pale blue or yellowish, posterior lobe prolonged back as a quadrate lobe, deeply and broadly notched, the angles of the notch prolonged as two horns which are angulated strongly forward, and, in profile, are shaped like the horns of an ox.

Thorax black on dorsum, pale blue laterally and beneath, the dorsum marked with a narrow pale blue antehumeral stripe on each side which lies nearer the humeral suture than the middorsal carina; on each side a narrow oblique black stripe incomplete below, bordering metepimeron.

Legs creamy white, extensor surfaces of femora, the lower or distal half of anterior femora on flexor surface and the flexor surface of tibiae black.

Wings hyaline, pterostigma black-bordered finely along costal border with white, covering 1 cell, braced, 19 postnodal nervures in forewings, 17 in the hind; *Riv* + *v* arising at subnode, *IRiii* well after it.

Abdomen blackish brown on dorsum, yellowish laterally, the sides of segment 8 broadly yellow, this colour extending up on to dorsum to meet above and form a narrow apical annule; basal half of segment 9 also yellow. Anal appendages black, conical, short, vulvar scale black, robust.

Distribution.—Tura, Garo Hills, Assam. Only a single specimen of this curious insect is known, the type, a female in the Indian Museum. Distinguished from all other species by the unique development of the posterior lobe of prothorax.

Coelliccia renifera (Selys) (1886)

Trichocnemis renifera Selys, Mem. Cour. xxxviii, p. 119 (1886), Laid, Fasc. Malay. (Odonata) part ii, p. 2 (1907).

Trichocnemis didyma Selys, (*C. renifera* nec *T. didyma*) Mem. Cour. xxxviii, pp. 118-119 (1886).

Coelliccia renifera Kirby, Cat. Odon. p. 128 (1893), Laid. Rec. Ind. Mus. vol. xiii, pp. 322, 332, 333 (1917), Fras. Journ. Bom. Nat. Hist. Soc., vol. xxix, p. 744 (1923).

Male. Abdomen 33-47 mm. Hindwing 22-23 mm.

Head,—labium pale brown tipped with black, labrum and bases of mandibles steely blue-black, anteclypeus and genæ pale sky-blue, postclypeus glossy black, vertex, occiput and beneath head velvety black, the former marked with obscure small triangular spots, one between each outer ocellus and the base of antennæ; a well-defined pale yellow transversely oval spot on each side of back of occiput, and a small yellow spot beneath head against the eyes, the latter olive green below, black at summit.

Prothorax velvety black, unmarked; posterior lobe rounded, simple.

Thorax velvety black marked with pale blue or pale greenish yellow—a broad oval-oblong spot on each side the middorsal carina extending about halfway up the dorsum, narrowly separated from each other by the black carinal ridge; each side broadly coloured, the anterior two-thirds of the mesepimeron except the part just beneath the roots of wings, and the whole of the metepimeron, the whole area narrowly divided by the postero-lateral suture which is finely black. Beneath entirely black.

Legs black on extensor surfaces of femora, and flexor surfaces of tibiae, opposite surfaces of these pale carneous or creamy white; coxæ and trochanters yellow anteriorly, black behind.

Wings hyaline; pterostigma black, finely framed in pale brown and thick black nervures, braced, covering about 1 cell; 18 to 20 postnodal nervures in forewings, 16 to 18 in the hind; *Riv+v* arising a short distance proximad to the subnode (or in Simla specimens, at the node or a shade before it, and sometimes in conjunction with *IRiii*), the latter arising at the subnode or a shade distad to it.

Abdomen black, yellow beneath; segment 1 with a small lateral pale yellow spot; segment 2 with its ventral border broadly pale blue or yellow (according to age); segments 3 to 6 with elongate subapical lateral creamy white or pale bluish spots, remaining segments unmarked.

Anal appendages creamy white, superiors beneath, and inferiors at base brownish black; superiors about as long as segment 10, conical and rather obtuse at apex as seen from above, cigar-shaped as seen from the side and with a small median black ventral spine; inferiors one-third as long again as superiors, broad at base, then cylindrical and curled gently in, their apices nearly meeting at the midline, sloping strongly up as seen from the side, apex obtusely rounded. Penis much broadened anteriorly and shallowly concave, the apical portion curling strongly over, presenting a small dorsal spine within the curve, and a small lappet-like lobe on either side just before the apex bifurcates into short branches which turn directly out at right angles to the body and end obtusely.

Female. Abdomen 42-46 mm. Hindwing 29-33 mm.

Differs in several respects from the male, the blue markings only present in very adult specimens, and usually creamy yellow.

Head similar to the male in most respects, differing as follows,—the pale markings of face pale greenish blue; the small triangular spot on vertex replaced by a chain of six spots, one in the same situation as that of male and connected narrowly with a second which extends out to the eye, lastly a third rounded spot lying between the outer and medial ocelli on each side; the spot on the under side of head against the eyes very much larger and broadly triangular.

Prothorax citron yellow with the whole of anterior lobe black, the middorsal ridge rather broadly and the hinder border; the posterior lobe vestigial, only a lateral rudimentary process on each side.

Thorax black on dorsum nearly as far lateral as the anterolateral sinus and marked with a pair of antehumeral narrow complete bluish green stripes; laterally pale blue, or yellow in subadults or teneral, marked with a very fine line on the postero-lateral suture; beneath pale blue or yellow, unmarked.

Legs yellow, all tibiae black on flexor surface; anterior pair of femora with a black stripe on front and back, confluent at distal end of limb; hinder two pairs with this marking much restricted, especially on the hind pair.

Wings as for male, palely enfumed in adults; 20-21 postnodal nervures in forewings, 18-19 in the hind; pterostigma with the pale brown frame much more in evidence; *Riv+v* more proximad the subnode, and *IRiii* always arising distad of that nervure.

Abdomen blackish brown, black towards the end segments, marked beneath and laterally, broadly with greenish blue changing to yellow on the end segments, and laterally and subapically expanding into largish spots; segment 8 with a broad apical yellow or bluish-green annule covering nearly half the segment; segment 9 nearly entirely pale blue or bluish-green, its base narrowly, and the sides broadly black, the black of base prolonged apicad as two submedian points. Occasionally the yellow annule on 8 narrowly interrupted on the middorsal carina; segment 10 brownish black, unmarked.

Anal appendages shorter than segment 10, conical, pointed, black; vulvar scales projecting beyond end of abdomen, very robust, bright yellow.

Distribution.—Upper Assam and Bengal, Sikkim and Simla States. The author has specimens from Darjeeling, Bengal, collected in July; from Pashoke, British Sikkim, collected in May, and from Gopaldhara, Assam, collected in September. Also some specimens from Barog, Simla Hills, 5,000 ft. collected in August, these latter being very small and evidently similar to the specimen described by Selys as from Darjeeling, and determined in error as *C. didyma*. The single thoracic dorsal marking and the black underneath

of thorax are in themselves sufficient to distinguish the insect from *C. didyma* which has two spots and a pale blue underside to thorax. These small Simla specimens do not differ in the slightest, except for size, from the larger forms from elsewhere. The single blue dorsal spot restricted to the lower half of the thorax will serve to determine this insect.

Coelliccia didyma (Selys) (1863).

Trichocnemis didyma Selys. Bull. Acad. Belg. (2) xvi, p. 155 (1863); Id. (*C. renifera* nec *didyma* Mem. Cour. xxxviii, p. 118 (1886).

Coelliccia didyma Kirby, Cat. Odon. p. 128 (1890); Laid. Rec. Ind. Mus. vol. xiii, pp. 322, 332 and 335 (1917); Fras. Journ. Bom. Nat. Hist. Soc., vol. xxix, p. 745 (1923); Laid Rec. Ind. Mus. MS. (1931).

Male. Abdomen 40 mm. Hindwing 26 mm.

Head labium yellow; labrum and postclypeus steely blue-black, bases of mandibles, genæ and anteclypeus pale sky blue, the former narrowly black at base; vertex and occiput velvety black, the former with a small triangular blue spot on each side lying between the ocelli and antennæ, the latter with a pyriform elongate pale yellow spot on each side; beneath head broadly pale blue; eyes olive green below, black above.

Prothorax black with a large pale blue spot on each side the middle lobe and the lower border narrowly; posterior lobe simple rounded.

Thorax velvety black on dorsum marked with two pyriform elongate antehumeral spots on each side the middorsal carina, a lower larger spot extending nearly halfway up the dorsum, pointed above, and an upper smaller spot extending from the antealar sinus for about one-fourth the length of dorsum and pointed below; laterally pale blue, the postero-lateral suture broadly mapped out in black; beneath palest blue, unmarked.

Wings hyaline; pterostigma blackish framed finely in pale brown and thick black nervures, braced, covering one and a half cells; 18 postnodal nervures in forewings, 17 in the hind; *Riv+v* arising a short distance proximad the subnode, and *IRiii* a similar distance distad that structure; *Ab*, especially in the forewings, arising a short distance distad the level of *Ac*.

Legs yellow, femora with a black stripe running the whole length of extensor and flexor surfaces, more extensive on the former, where it is continued on to the trochanters and coxæ; tibiae black on flexor surface.

Abdomen black on dorsum and sides, pale yellow beneath, the sides of segment 1 broadly yellow, the lower part of sides of segment 2 narrowly so; a linear longitudinal streak of yellow on dorsum of the latter segment, not quite extending to apical border; segments 3 to 6 with small paired pale blue basodorsal spots; segments 7 and 8 entirely black save for a narrow border bluish on the latter near the ventral surface; segments 9 and 10 pale blue, but the basal third of former with a broad annule of black.

Anal appendages livid or pale yellow, the base of superiors and the apices of inferiors blackish; superiors slightly longer than segment 10, conical and hollowed out within as seen from the dorsum, narrow at base, with a broad ventral tooth, tipped with black, and the obtuse apex with a shallow dorsal notch as seen from the side; in semi-profile view, a fine black spine seen near the base within; inferiors slightly longer than superiors, very sinuous as seen from the side, the apex obtuse, rounded and curled slightly down and markedly in.

Female unknown.

Distribution.—Described from a specimen from Kedah Peak, Simla States, 3,800 ft. taken by Capt. Cardew, 29-3-1928. The type, in the Selysian collection is an incomplete male, with end of abdomen missing, locality Thibet. Subsequently Selys described a small form of *C. renifera*, from Darjeeling, as a male of this species, giving the supposed and completed description of *C. didyma*. The female still remains to be discovered. The species is easily distinguished from all others by the two pyriform dorsal thoracic spots, pale blue in colour. *C. loringæ* which is very closely related to it differs by the

lower of the two dorsal spots being broader and deeply bifid along its upper border and also by the blue markings of abdomen extending well onto segment 8, instead of restricted to the apical half of 9 and segment 10.

Coelliccia loringae Laidlaw (1931).

Coelliccia loringae Laid., Rec. Ind. Mus. MS (1931).

Male. Abdomen 42 mm. Hindwing 27 mm.

Head, labium white; labrum and postclypeus glossy black; bases of mandibles, genæ and lateral part of frons and the anteclypeus pale sky-blue; rest of head velvety black with a small oval spot obscurely blue on each side of vertex between the lateral ocelli and bases of antennæ, and an elongate pyriform post-ocular spot pale yellow on each side of occiput; beneath black, eyes bordered irregularly with pale blue; eyes olivaceous beneath and at sides, black above.

Prothorax velvety black with a broad border on each side confluent with an elongate spot on the side of middle lobe, pale sky-blue; posterior lobe simple, rounded.

Thorax velvety black on dorsum where are seen two large pale sky-blue spots on each side, a smaller upper spot near the antealar sinus and upper part of humeral suture, extending slightly less than one-third the length of dorsum, and a large broad lower spot extending for the lower two-thirds of dorsum, bordering the middorsal carina inwardly and with a tongue-like projection on the outer side near the humeral suture, giving a bifid appearance to the spot: laterally pale sky-blue with the postero-lateral suture narrowly outlined in black; beneath palest blue.

Legs white, extensor surfaces of all femora black, as also the distal end of the flexor surface of hind pair; tibiæ black on the flexor surface; tarsi entirely black.

Wings hyaline; pterostigma blackish brown, paler at margins, covering one to one and a half cells, strongly braced; 19 to 20 postnodal cells to forewings, 19 in the hind; *Riv+v* and *IRiii* arising together from the subnode, or *IRiii* slightly distad that nervure; rarely *Riv+v* a shade proximad to the subnode.

Abdomen black marked with pale sky-blue as follows: segment 1 broadly blue at the sides and more narrowly so at apex, the black dorsal spot just reaching that border at a point; segment 2 broadly blue at the sides, and with a narrow middorsal stripe extending for three-fourths the length of middorsal carina; segment 3 with a narrow basal annule narrowly interrupted on the middorsum, and a very broad subapical annule also narrowly interrupted on the middorsal carina; this annule confluent with the blue of sides and beneath; segments 4 to 6 very similar but the basal annules reduced to two small basal spots which are gradually reduced in size towards segment 6; segment 7 similar but the basal spots absent; segment 8 with a broad blue apical annule resting on apical border and covering about the apical half of segment, more so subdorsally; segment 9 entirely blue, whilst 10 is blue with a large trilobed black spot on apical border, the middle lobe of spot extending to base of segment.

Anal appendages pale creamy yellow, exactly similar in shape to those of *C. didyma*, except for the basal spine of superiors which is absent. Penis similar in shape to that of *C. didyma*, apex very broad and a little sinuous, very shallowly excavate, curling up over stem of organ and deeply cleft into two long slim branches which curl down and forwards and, at the extreme apices, again backwards. A strong dorsal spine within the curling arch of apex.

Female. Abdomen 41 mm. Hindwing 27 mm.

Differs in several respects from the male; labrum bright ochre, its base narrowly black; postclypeus black with a rounded yellow spot on each side; bases of mandibles and genæ bright yellow; the isolated spots on vertex replaced by a complete transverse stripe or with a slight interruption at the middle of head, this stripe very sinuous and traversing vertex between the ocelli; elongate spots behind eyes bright yellow; bordering of eyes beneath yellow.

Prothorax black, broadly yellow at the sides and beneath, posterior lobe reduced to a small median tongue-like projection directed straight back.

Thorax black marked with bright yellow as follows,—a very narrow ante-humeral stripe on each side of dorsum and a tiny upper humeral spot; the sides

and beneath all yellow save for a narrow black oblique stripe mapping out the postero-lateral suture.

Legs yellow, marked similarly to the male but tibiae are entirely yellow, as also the trochanters and coxae; tarsi black.

Wings similar to the male in most respects; pterostigma reddish brown between black nervures; 19 to 20 postnodal nervures in forewings, 17 in the hind; *Riv+v* slightly proximad the subnode; *IRiii* at a greater distance distad, but the two arising very close together as in the male.

Abdomen black with a bright yellow stripe running the whole length of sides; segment 3 with a pair of basal subdorsal spots confluent with this yellow stripe; segment 1 broadly yellow, its dorsum with a broad triangular black spot which reaches apical border at a point only; segments 2 to 6 with the middorsal carina finely yellow; segment 8 with nearly its apical half bright ochreous but a small apical dorsal triangle of black with its apex bifid and directed basad; segments 9 and 10 wholly bright ochreous.

Anal appendages short, conical, pointed, bright ochreous as well as a conical protuberance beneath and between them. Vulvar scales ochreous, extending to end of abdomen.

Distribution.—Upper Burma. The type, in the author's collection, is from Gokteik, Upper Shan States; other specimens were taken at Maymyo, Upper Shan States, Burma, during June and July. The species is only to be confounded with *C. didyma* from which however it is easily distinguished by the shape of the lower dorsal thoracic spot, by the conspicuous subapical blue annules on abdomen and by the blue markings at end of abdomen extending onto segment 8 as well as the whole of segment 9. The origins of *Riv+v* and *IRiii* are also different and the nodal index is higher.

Coelliccia loogali Laidlaw (1931).

Coelliccia loogali Laid., Rec. Ind. Mus. MS. (1931).

Male. Abdomen 42–43 mm. Hindwing 28 mm.

Head,—labium pale yellow; labrum and postclypeus glossy black, the latter with a small spot at each side pale sky-blue; bases of mandibles, genae and outer part of frons pale sky-blue; rest of head black, the vertex with an obscure triangular spot on each side lying between base of antennae and outer ocelli, the occiput with a transversely elongate spot on each side behind eyes; beneath black broadly pale sky-blue against the eyes; eyes dark olivaceous green at sides and beneath, black above.

Prothorax black with a broad pale sky-blue stripe on each side below; posterior lobe simple, rounded.

Thorax velvety black on dorsum to well beyond level of humeral suture, marked with a pair of antehumeral pale sky-blue narrow curved stripes with the convexity facing outwards and extending the whole length of dorsum; a small upper humeral spot of the same colour, occasionally quite large, sometimes obsolete; laterally pale sky-blue with a small black spot on the upper end of the postero-lateral suture and a similar spot below; beneath pale sky-blue.

Wings hyaline; pterostigma blackish grey, in a lighter frame and thick black nervures, braced, covering one and a half cells; *Riv+v* arising well proximad of the subnode, *IRiii* slightly after that structure or occasionally opposite it; 19 to 23 postnodal nervures to forewings, 18 to 19 in the hind.

Legs pale yellow as well as trochanters and coxae, femora lined with black on extensor surfaces, tibiae black on flexor, tarsi black.

Abdomen black on dorsum, pale blue to yellow on lower part of sides of segments 3 to 6, segment 1 broadly blue on the sides, segment 2 more so than on the following segments; remainder black.

Anal appendages deep black as for abdomen, the superiors tipped with bright yellow at apex and another spot of yellow on apex of ventral spine; seen from above, conical with an inner ventral subapical robust spine, giving a bifid appearance to the apex of appendage, on either side of which groove is seen the strongly contrasted small yellow spots; inferiors one-fourth longer than superiors which are about as long as segment 10, tapered, very sinuous and with apical end turned strongly inward and down. Penis broadly dilated at apex and rather deeply notched at centre, the end curling strongly over stem.

of organ and ending in two broad lobes which embrace the stem closely on either side.

Female. Abdomen 40-41 mm. Hindwing 28 mm.

Differs in but few respects from the male, much less so than in other species of the genus. The labrum broadly bordered with yellow in all but very old specimens; the outer spots on the postclypeus yellow and very small or almost obsolete in adult specimens; the blue of genæ extending inwards across frons to a greater degree; a narrow zig-zag transverse stripe across vertex made up of six small blue spots behind the antennæ and linking up the ocelli in a chain; blue beneath head more extensive; prothorax and thorax as for male but the posterior lobe of former reduced to a tiny median point and a small outer isolated lobe; wings entirely similar to the male but palely enfumed in adults. Abdomen similar to the male except the terminal three segments,—segment 8 with a broad apical annule yellow covering slightly more than one-third the length of segment and confluent below with a yellow border; segment 9 dark reddish brown with the apical border yellow or ochreous gradually vignetted off into the darker colour; segment 10 very short, black.

Anal appendages black, conical, rather shorter than segment 10; vulvar scales robust, yellow tipped with black beneath, extending a little beyond end of abdomen.

Distribution.—Maymyo, Upper Shan States, Burma, during June and July. A number of males and three females in the author's collection. Type and paratype to be deposited in the British Museum collection. The species is easily distinguished from others by the curved blue antehumeral stripes on dorsum of thorax, by the lateral blue spots on postclypeus, by the very black abdomen of male, almost unmarked, especially the terminal segments, and by the black anal appendages tipped with two small bright yellow spots. The female is determined by the lateral spots on postclypeus and the broad terminal yellow rings on segments 8 and 9 followed by a black unmarked segment 10.

Coellicia poungyi Fraser.

Coellicia poungyi Fraser, *Journ. Bom. Nat. Hist. Soc.* vol. xxx. pp. 52 and 53 (1926).

Male. Abdomen 43-40 mm. Hindwing 23-25 mm.

Head,—labium black, white at base; labrum, bases of mandibles and lower half of genæ, ante- and post-clypeus glossy black; upper half of genæ palest blue, this colour encroaching slightly on frons, which is black; vertex and occiput matt black, the former with two oval spots with their bases on the posterior ocelli and apex directed towards the bases of antennæ, the latter with an elongate pyriform creamy yellow spot; beneath head black, narrowly bluish against the eyes; eyes black above, olivaceous green at sides and below.

Prothorax velvety black, the lower part of sides pale blue; posterior lobe rounded, simple.

Thorax velvety black in the humeral area, pale sky-blue on dorsum and laterally from about the middle of mesepimeron. Dorsum almost entirely blue, the middorsal carina finely black, as also the antealar sinus above, and the small triangular area below in which the carinal ridge ends; a small upper humeral spot sometimes present; laterally the postero-lateral suture heavily mapped out in black; beneath palest blue.

Legs black; coxæ and trochanters posteriorly pale blue.

Wings hyaline; pterostigma black or very dark brown, covering 1 cell, braced; 17-18 postnodal nervures in forewings, 16 in the hind; *Riv+u* and *IRiii* often arising very close together, the former usually very slightly before the subnode but occasionally at its level, the latter generally slightly after or rarely at its level.

Abdomen black; segment 1 with the apical half of its sides pale blue, extending up along the apical border and nearly confluent over dorsum; segment 2 with a narrow longitudinal stripe on each side at the ventral border, also a narrow linear stripe along the middorsal carina, the latter pale creamy white; segment 3 with a pair of small subdorsal bluish spots at base and its middorsal carina finely yellow, this latter continued for a short distance on to segment 4; segments 9 and 10 bright chrome yellow.

Anal appendages bright yellow; superiors as long as segment 10, narrow at base, broadening at middle and again slightly tapered to apex which is bluntly conical, a small black-tipped ventral spine just beyond the middle and a smaller short spine near the base, which is seen with difficulty; inferiors one-third longer than superiors, broad at base, then unguulate and very sinuous, blunt and rounded at apices which are curved slightly inwards. Penis differing broadly from that of other species, very broad at apex which is a little sinuous, the end curling over strongly and ending in three processes, a median tongue-shaped lobe directed straight back over stem of organ, and two very thin, long, greatly curled branches, which curve down like a watch-spring on each side of the organ.

Female. Abdomen 40 mm. Hindwing 26 mm.

Differs rather broadly from the male, the blue markings replaced by bright ochre. Labium yellow; labrum bright yellow with two large black basal spot, narrowly joined across the middle; bases of mandibles, genæ and a large spot on each side of postclypeus bright ochereous; the oval spots on vertex replaced by a continuous transverse and very sinuous bright yellow stripe traversing the vertex between the ocelli; elongate spots behind eyes bright yellow, beneath eyes almost entirely bluish green.

Prothorax black, broadly yellow on the sides; posterior lobe almost obsolete, a mere median vestige present.

Thorax black on dorsum to nearly as far as the antero-lateral suture, marked with a narrow bright yellow antehumeral stripe on each side of dorsum; laterally and beneath yellow with a short vestige of a narrow black stripe on the upper part of postero-lateral suture.

Legs yellow, posterior surfaces of femora and anterior of tibiæ black; tarsi black.

Wings hyaline, pterostigma brownish black at centre framed in pale yellow and thick black nervures; 19 postnodal nervures to forewings, 17 in the hind; *Riv+v* arising widely proximad the subnode, *1Riii* in continuation of the nervure descending from it or occasionally very slightly distad of it.

Abdomen black with a broad yellow stripe extending along its whole length, more extensively so on segment 1; segment 8 with rather more than its apical third bright ochereous, whilst segments 9 and 10 are entirely of this colour. Anal appendages short, conical, pointed, yellow, as also a conical protuberance beneath and between them.

Distribution.—Upper Shan States, Burma. The type, a male in the British Museum, is from Maymyo, paratype female and males in the author's collection were taken during June and July.

The species is determined from others by the whole of dorsum of thorax pale sky-blue, whilst the female differs by the whole of the under-surface of eyes pale greenish blue and segments 8 to 10 yellow, rather less than the basal two-thirds of the former black, the apical border unmarked.

Coelliccia chromothorax (Selys) (1891).

Calicnemis chromothorax Selys, Ann. Mus. Civ. Genov. (2) x, pp. 70-71 (1891); Laid; Rec. Ind. Mus. vol. xiii, p. 327 (1917); Fras., Journ. Bom. Nat. Hist. Soc., vol. xxix, p. 74 (1923).

Coelliccia chromothorax Laid., Rec. Ind. Mus. MS. (1931).

Male. Abdomen 42-43 mm. Hindwing 26-29 mm.

Head,—labium yellow tipped with black; labrum, bases of mandibles, genæ, clypeus, vertex and occiput black, the vertex with a small oval yellow spot lying between the posterior ocelli and antennæ on each side, the occiput with an elongate transverse pale yellow stripe on each side of occiput behind eyes, and a small point of yellow against the eyes beneath; eyes black on top, olivaceous laterally and beneath.

Prothorax black, sides of middle and anterior lobes broadly yellow; posterior lobe rounded, simple.

Thorax bright sulphur yellow on dorsum, the middorsal carina finely black, as also the antealar sinus and the small triangular area below at end of carinal ridge; the humeral area broadly velvety black as far as the antero-lateral suture, and with a small yellow point above just behind the upper end of humeral suture; laterally and beneath pale yellow with a narrow black stripe mapping out the postero-lateral suture, but incomplete below.

Legs yellow with extensor surfaces of femora, and flexor surfaces of tibiae black, as well as tarsi.

Wings hyaline, palely enfumed in adults; pterostigma black very finely framed in yellow, covering rather less than 2 cells, braced; *Riv+v* very variable in origin, often fused with *IRiii*, or arising well before, slightly before or at the level of subnode; *IRiii* arising at or distad the subnode; 19-22 post-nodal nervures in forewings, 18 to 22 in the hind. Origin of anal bridge variable, arising at or a short distance proximad of *Ac*.

Abdomen black, the ventral border yellow as far as segment 6, broadly so on segment 1 where it passes up on dorsum and is narrowly confluent at the apical border; segment 2 with its middorsal carina finely yellow, as also segments 3 and 4; a pair of small bright yellow baso-dorsal spots on segments 3 to 5, that on 3 being confluent with the yellow on side; the apical border of segment 9 and the whole of segment 10 bright chrome yellow.

Anal appendages bright yellow; superiors about as long as segment 10, broad at base, broad and shallowly notched at apex as seen in profile, obtuse at apex as seen from dorsum, a small spine tipped with black on the ventral inner surface about middle of appendage; inferiors broad at base, unguate and very sinuous thereafter as far as apex which is rounded in profile, but curled strongly in and acute as seen from above. Penis with very blunt apex, cupped and with two very narrow branches springing from its middle which curl strongly back to embrace stem of organ and then turn abruptly back at ends; a robust spine on dorsum of stem lying within the arch of apex.

Female. Abdomen 40 mm. Hindwing 28 mm.

Differs in several respects from the male, shorter and more robust; bases of mandibles, genæ, anteclypeus except for a small black spot on each side, and the anterior border of frons very finely yellow; 2nd joint of antennae tipped with yellow; oval spots on vertex replaced by a beaded transverse stripe traversing the vertex between the ocelli; elongate spots behind eyes larger; eyes bordered narrowly with yellow beneath.

Prothorax very broadly yellow at sides; posterior lobe almost absent, merely a small black lobe on each side, the broad notch between bright yellow.

Thorax black on dorsum marked with a narrow bright yellow antehumeral stripe on each side which replaces the broad sulphur yellow fascia seen in the male. Laterally similar to the male.

Legs and wings similar to the male; 20 to 21 postnodal nervures to forewings, 19 in the hind; *Riv+v* and *IRiii* arising a little proximad and a little distad of the subnode respectively; *Ab* arising at the level of *Ac*.

Abdomen black with a yellow stripe running along the whole length of the ventral border; segment 1 entirely bright yellow save for a small dorsal basal black spot; segment 8 with a large apical dorsal spot covering nearly its apical half; segment 9 with a similar spot, but bifurcating into two lobes which run slightly outwards and nearly as far as base of segment; segment 10 black with the dorsum yellow or more commonly, a small round spot on each side the middorsal ridge at the middle of segment.

Anal appendages black, short, conical, pointed; vulvar scales robust, not extending quite to end of abdomen, yellow, blackish below.

Distribution.—Upper Burma; the type comes from Puepoli and is in the Selysian collection. Occurs at Maymyo, Upper Burma from June to August. Paratypes in the author's, and British Museum collections. The male is easily distinguished from all others of the genus by the whole of dorsum of thorax bright sulphur yellow; not infrequently the anal bridge is found to arise proximad the level of *Ac*, thus differing from other species and approximating to *Calicnemis* and *Indocnemis*. The female is distinguished by the yellow markings on the terminal abdominal segments which are very distinctive.

Coelliccia fraseri Laidlaw (1931).

Coelliccia fraseri Laid. Rec. Ind. Mus. MS. (1931).

Male. Abdomen 37 mm. Hindwing 23 mm.

Head,—labium pale yellow; labrum dark brown bordered with paler brown; bases of mandibles, genæ, anteclypeus and the lateral part of frons pale blue; vertex and occiput and beneath eyes matt black, the former with a pair of round bluish spots lying in the triangle formed by the ocelli, and an oval spot

on each side between the ocelli and base of antennæ; occiput with a vestigial pale yellow oblong spot on each side behind the eyes; the latter black above, olivaceous on the sides and beneath.

Prothorax black, broadly blue or yellow laterally; posterior lobe rounded, simple.

Thorax black on dorsum as far lateral as the anterior half of the mesepimeron, marked by very narrow dorsal blue or yellow stripes which lie close to and parallel with the middorsal carina, extending the whole length of dorsum. Laterally and beneath pale blue with a narrow black stripe mapping out the postero-lateral suture, incomplete below; a small spot, sometimes obsolete, on the upper part of humeral suture.

Legs yellow, posterior surfaces of femora and the tarsi black. Wings hyaline; pterostigma reddish brown framed in pale yellow and thick black nervures, covering one and a half cells, braced; 16 to 17 postnodal nervures to forewings, 15 in the hind; *Riv+v* arising at a variable distance proximad to subnode; *IRiii* arising at or a little beyond subnode.

Abdomen blackish brown on dorsum, bluish near base and yellow elsewhere on the sides; segment 1 broadly blue or yellow laterally; segments 3 to 7 with small paired basal dorsal spots confluent with the yellow on sides and beneath; segments 7 to 9 black on dorsum; segment 10 black changing to reddish brown and then broadly yellow on the side. Some specimens with the apical border of segment 9 broadly pale yellow, the base black, this extending as two dorsal points apicad; segment 10 in the same specimens wholly pale yellow.

Anal appendages pale yellow, inferiors black on dorsum and apices; superiors narrow at base and hollowed out as seen from above, then broadening and club-shaped, very obtuse at apex and with two inner points or broad spines at their middle; inferiors broad at base then tapered and ending in an obtuse or rounded apex which is slightly curled in as seen from above. Penis closely similar to that of *C. chromothorax* but the branches forming a watch-spring spiral and not directed back at ends.

Female. Abdomen 33 mm. Hindwing 24 mm.

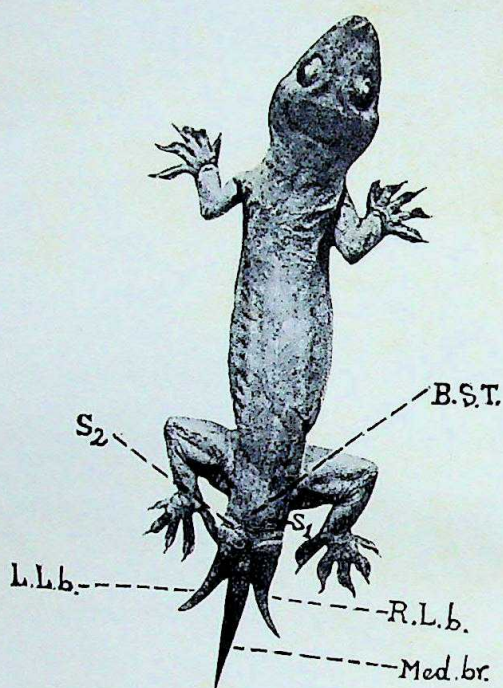
Closely similar to the male, far more so than is general within the genus; differs as follows, labrum golden yellow with a tiny black point at base in the middle line; blue of genæ almost meeting across frons; spots on vertex coalesced to form a complete slightly beaded stripe extending from eye to eye between the ocelli.

Prothorax bright yellow, anterior and posterior lobes deep black, as also a fine middorsal line on middle lobe; posterior lobe trilobate, projecting markedly over front of thorax. Wings with pterostigma ochreous, the central portion brownish; 17 to 18 postnodal nervures in forewings, 15 to 16 in the hind; *Riv+v* and *IRiii* variable as in the male. Abdomen similar but segment 8 with a broad apical yellow annule occupying one-third of its length; segment 9 variable, dark brown or obscurely marked with yellow on dorsum and apical border; segment 10 reddish brown as also anal appendages which are short, conical pointed.

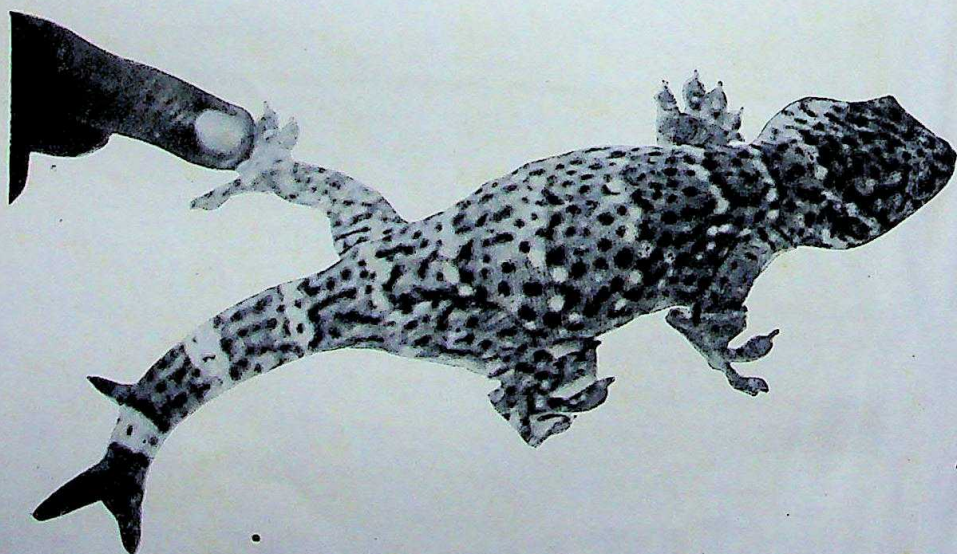
Vulvar scales moderately robust, yellow, the base and beneath black.

Distribution.—Khasia Hills, Assam. The type in the British Museum comes from Shillong, 5,000 ft. The species is stated by Mr. T. Bainbrigge Fletcher to be common in jungle near streams in June and July, extending into August. Distinguished from other species by the parallel blue or yellow dorsal lines on thorax lying in close apposition to the middorsal carina. The female bears the same marking which will serve to determine it from the females of other species from India. Only old adults have blue thoracic markings, and in very old specimens, the dorsal stripes are completely obliterated.

(To be continued),



Dorsal view of *Hemidactylus flaviviridis*, Rüppel with a trifid tail. Specimen B.



Dorsal view of *Gecko verticillatus*, Laurenti with a trifid tail produced artificially.

OBSERVATIONS ON THE TRIFID TAILS IN TWO SPECIMENS OF
HEMIDACTYLUS FLAVIVIRIDIS, RÜPPEL, WITH A NOTE¹
ON THE ARTIFICIAL REGENERATION OF DOUBLE AND TRIPLE
TAILS OF THE "TOKHAK" LIZARD, *GECKO*
VERTICILLATUS, LAURENTI.

By

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Calcutta.

(With 1 plate and a text-figure.)

INTRODUCTION.

Two specimens of ordinary house-lizards (Geckos), each with a trifid tail, were caught—one from the students' quarter, 35, Ballygunge Circular Road, Ballygunge, Calcutta, by the author himself and the other from the Professors' quarters situated within the compound of the same premises by Master Ajit Kumar Sarkar. The chief interest lies in the fact that under ordinary circumstances, the regenerated tail in Geckos is generally a straight continuation (without any sign of segmentation on the surface, except for certain differences in scaling) of the portion of the original tail left intact, whereas in the present case each specimen bears two lateral accessory regenerated branches in addition to the median regenerated tail. From a careful study of the detailed structure it was found that these two lateral branches of the tail differed markedly from the median one, and also from the double and the triple tails which were produced artificially in the laboratory by injuring either certain portions of the vertebral column of the normal tail or the cartilaginous tube of the regenerated tail of *Gecko verticillatus*.

Regeneration of tails in Geckos is not an uncommon feature, and has been referred to by several authors, and the literature dealing with allied or nearly related cases has been cited in the present communication.

GENERAL DESCRIPTION.

The description of the two specimens of *Hemidactylus flaviviridis*, Rüppel, each possessing a trifid tail, is as follows:

I. External Characters—Specimen A (Figs. 1 and 2).

(a) Measurements:

- (i) Length from snout to the vent.....8.6 cms.
- (ii) Greatest breadth across the abdomen.....1.95 cms.
- (iii) Length of the head.....2.35 cms.
- (iv) Breadth of the head.....1.63 cms.

The portion of the original tail left intact (Figs. 1 and 2; S_1-S_5), measured 2.3 cms. from the vent. This piece of the original tail, as seen externally, is composed of five segments (S_1-S_5), each segment being marked by the presence of four large conical scales except the basal segment (B.S.T. or S_1), where such scales are not represented. Two of these large scales are lateral in position, and are much more prominent than the two mid-dorsal ones. The whole of the regenerated tail (Med. br.) measures 4.35 cms. in length from its origin up to its tip. At a distance of nearly 9 mm. from base of the regenerated tail there arise two small accessory lateral branches apparently from the dorso-lateral walls of the regenerated tail itself. The latter is thus continued as the median tail (Med. br.), though there is a slight indication of a groove on

¹ Cf. Proceedings of the Indian Science Congress held at Nagpur in 1931.

either side, both along the dorsal and the ventral sides, just behind the origin of the two small lateral branches. The grooves run from the lateral sides, converging towards the antero-mesial direction. The right lateral branch (R.L.b) measures 4.5 mm. in length, whereas the left one measures 3.5 mm. The median branches of the tail (Med. br.) measures 3.45 cms. in length from

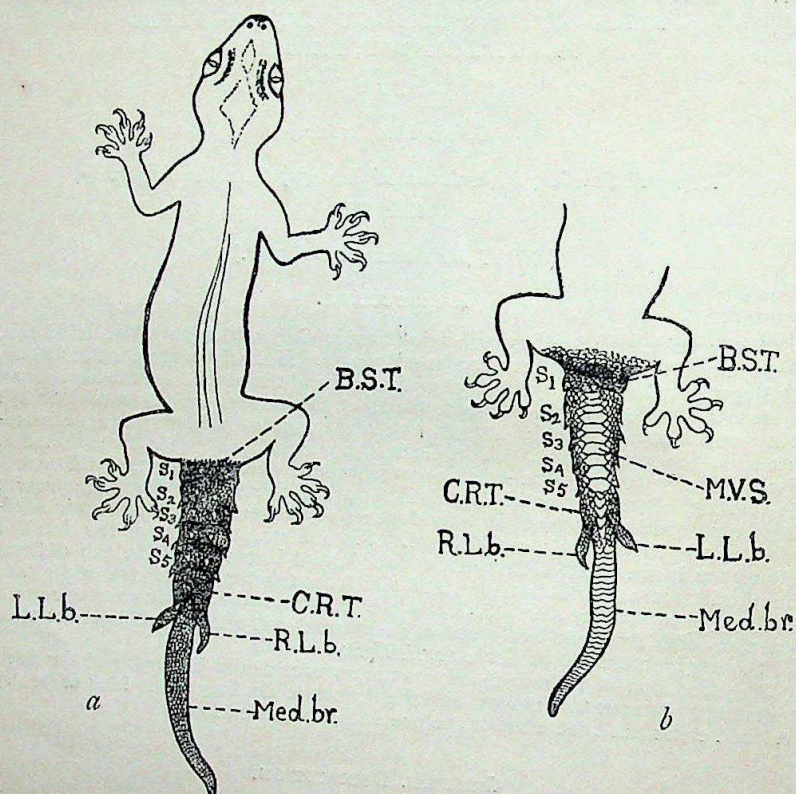


FIG. 1. Diagrammatic sketch of *Hemidactylus flaviviridis*, Rüppel, with a trifid tail; Specimen A. *a*. Dorsal surface; *b*. ventral aspect of the tail region

behind the origin of the lateral tails. The diameter of the common trunk of the regenerated tail, i.e. of the common basal stump (C.R.T.), supporting the lateral accessory as well as the median tails, immediately in front of the two lateral branches, is about 7 mms., whereas the diameter of the base of the median branch lying just behind them is about 4.5 mm.

(b) Scaling:

As regards scaling there is a very marked difference between the original portion (i.e. part of the normal tail left intact) and the regenerated portion of the tail. In the former case the scaling on the dorsal surface is more regular, and each segment as seen externally has four large conical scales as referred to above, which are absent from the regenerated tail. The general covering of scales (dorsal and lateral) over the region of the tail in front of the origin of the two lateral accessory branches, i.e., both over the normal portion of the tail as well as over the common regenerated trunk, are small and very nearly of the same pattern, while those over the three regenerated branches (i.e., the two lateral branches and the median one) are slightly larger and dissimilar, and are arranged irregularly. The mid-ventral row of large laterally elongated

TRIFID TAILS OF LIZARDS

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scales (fig. 2 b; M.V.S.) prominently seen on the original tail, also extends over the common regenerated trunk as well as over the median branch of the regenerated portion of the tail, but here they are strikingly different in form and shape; and the lateral branches, viz., the accessory tails, are devoid of such large scales; in other words, the latter are covered over by small scales only which are of the same pattern both on the dorsal and the ventral sides.

(c) Colouration:

As to the colouration, the three regenerated branches are slightly more greyish in appearance than the rest of the tail.

SPECIMEN B. (Pl. 1)

(a) Measurements:

- (i) Length from snout to the vent.....8.1 cms.
- (ii) Greatest breadth across the abdomen.....1.95 cms.
- (iii) Length of the head.....2.1 cms.
- (iv) Breadth of the head.....1.65 cms.

The portion of the original tail (Pl. 1, S_1 - S_2) left intact measured 7.5 mm. This portion of the original tail is really composed of two segments, and, as seen externally, it is marked by a definite groove which separates the basal segment (B.S.T. or S_1) from the posterior one (S_2)—both of these having no conical scales: the absence of such scales from the posterior segment is an uncommon feature, and is probably due to destruction caused by certain injuries over the area bearing these scales. Out of the three branches of the regenerated tail, the median branch (Med. br.) is larger than the two lateral ones and measures 2.45 cms., whereas the right lateral branch (R.L.b.) measures 1.75 cms., and the left one (L.L.b.) 1.7 cms. The two lateral accessory branches are comparatively larger than those of the specimen A, but the median regenerated tail is relatively smaller. The three branches of the regenerated tail arise directly from the very end of the original tail left intact, and not from a common regenerated trunk as in specimen A described above. A posterior groove on either side is very well-marked (especially on the dorsal side), and runs from just behind the base of each lateral tail towards the antero-mesial direction as seen in specimen A, but the line of demarcation between the original portion of the tail and the regenerated portion is very clearly marked in this particular specimen (not so well differentiated in the former case), and runs postero-mesially from the lateral sides to meet at a common point at which the two posterior grooves (just mentioned) also unite. The diameter of the common base (from which are given off the three branches) of the regenerated tail is 1.2 cms., whereas the base of the median branch, i.e. of the region lying immediately behind the origin of the two lateral accessory branches, measures .4 cm. across its diameter.

(b) Scaling:

The dorsal scaling of the three regenerated branches differs from that of the original tail in being irregular and larger in size, but the mid-ventral row of laterally elongated scales are present on all the three branches, and are of the same pattern. In this respect, viz., in the possession of the mid-ventral row of scales on all the three regenerated branches of the tail, specimen B differs very strikingly from specimen A.

It is a noteworthy fact that the scales of the regenerated (renewed) tail, or of the accessory tails differ from those of the original (normal) tail in those reptiles, which have the power of reproducing their tail, but according to Boulenger (3) this view is erroneous, and "in some cases, the aberrant scaling of the reproduced tail is a reversion to an ancestral form."

(c) Colouration:

The colouration of the regenerated tail is pretty nearly the same as in specimen A.

HISTOLOGY.

Specimen A.

In the regenerated tail, as we know, a cartilaginous tube extends from the very end of the portion of the original tail left intact, in continuation with the last vertebra (i.e. the portion actually left over), up to the end of the regenerated tail. By section-cutting it is found that the two lateral accessory branches

bear no such cartilaginous tube as that seen in the median regenerated portion in which it is continued straight backwards from its base. There is a fairly well-developed groove encircling the cartilaginous tube, i.e., there is a distinct constriction at the point from where the two lateral tails are given off. Serial frontal sections also show that the cartilage cells at the constriction are comparatively much larger than those of the other parts, and are in a state of proliferation, and they push their way inwards towards the central canal lodging the spinal cord. There is also a connective tissue investment encircling the tube, but this is interrupted at the constriction.

The histological condition of the central cartilaginous tube, viz., the presence of a very distinct constriction as well as discontinuity of the connective tissue sheath in the constricted area, suggests that probably the anterior portion of the regenerated tail, i.e., the basal stumpy portion (Figs. 1 and 2; C.R.T.) is *primarily* regenerated from the sides of which are developed the two accessory fleshy lobes (R.L.b. and L.L.b.), whereas the median part (Med. br.) of the tail is *secondarily* regenerated—the fleshy lobes being probably formed after the median part has sufficiently developed due to certain injuries being received over the common regenerated trunk near the junction of the two portions of the regenerated tail.

The cartilaginous tube is devoid of any segmentation and perforation. It tapers with the tail, and its lumen ends blindly at the tip.

Neural and hæmal arches are wholly wanting in the area of regeneration.

Inside the lumen of the cartilaginous tube the following structures are present:—

(a) The tapering part of the spinal cord in continuation with the cellular lining of the canalis centralis, and practically having very few external nerve fibres.

(b) A network of blood-vessels—the capillaries being irregularly disposed here and there.

(c) A very few pigment cells are also scattered about.

(d) The fatty layer is extremely thick, and consequently the musculature is thin within the median regenerated tail, but the two lateral accessory branches are mainly muscular outgrowths with a limited number of adipose cells.

Specimen B:

As in specimen A the cartilaginous tube is one continuous piece, and forms the central axis of the median regenerated tail only. The lateral branches are devoid of any such structure; that is to say, these are merely fleshy outgrowths, without any hard supporting structure inside them. Further, in the absence of any groove or constriction towards the anterior part of the cartilaginous tube and in the presence of a continuous sheath of connective tissue, it is so very characteristically different from the previous case already described.

It appears that in this case *the whole of the newly added tail is primarily regenerated*, and owing to injuries having been received towards its anterior end, two fleshy lobes (Pl. 1; R.L.b. and L.L.b.) have thus developed later in life. But the injuries in this specimen had possibly also affected the mid-ventral row of scales of the regenerated tail, which probably thus led to the extension of these scales over the ventral sides of the lateral branches as well, whilst it might be remarked that in specimen A the injuries had not gone far enough to affect the mid-ventral row of scales, and consequently, the latter was absent from the accessory lateral tails of that specimen.

GENERAL REMARKS.

To be brief, it may be said that the regeneration or the production of double or triple tails in lizards (1, 2, 4, 5, 6) is by no means an uncommon phenomenon under natural conditions. That might be due to certain accidents, either to partial injuries to the muscular coat only, or to deeper injuries affecting the muscular layers as well as one or more vertebrae of the original tail.

Tornier (7) has been able to produce experimentally double and triple tails in the case of *Lacerta agilis* with cartilaginous tubes forming the central axes or supporting structures for the lateral outgrowths.

Woodland (8) has succeeded in producing an extra tail without any cartilaginous tube entering into it in each of the four examples of *Hemidactylus*

flaviviridis, Rüppel. This accessory tail is, therefore, simply a muscular outgrowth from the side of the original tail, or from that of the regenerated tail.

From a series of well-graded experiments conducted on the caudal autotomy of a less common lizard, *Gecko verticillatus* (pl. 3) in the laboratory by injuring the tails in various ways, I have observed in nearly all cases (out of many double and triple tails having been produced), that a lateral outgrowth or accessory tail is produced from the normal, or from the regenerated tail without any supporting skeletal structure when the injury is not sufficiently deep, i.e., when it affects the muscular coat only. In such cases, the accessory regenerated tails are merely elongated fleshy lobes, but if the wound is sufficiently deep, and has affected either the vertebral column of the original tail, or the central cartilaginous tube of the regenerated tail, then in all such cases, an accessory cartilaginous tube¹ is also developed from the point of injury, and extends as a supporting structure inside the accessory regenerated tail.

From the experimental results on the regeneration of tails in certain Lacertilians obtained by Tornier (7), Woodland (8), myself and others, it clearly follows that an accessory tail without a cartilaginous tube may not be an unusual feature, and that in order to produce an accessory tail with a central cartilaginous tube, the injury must be deep enough to reach the vertebral column of the original tail, or the central cartilaginous tube of the regenerated tail.

The three-tailed condition (or the trifid tails) of the two specimens of *Hemidactylus flaviviridis*, each possessing, i.e., two accessory fleshy lobes without any supporting skeleton, together with the median regenerated tail bearing a central cartilaginous axis, is undoubtedly the outcome of injuries apparently received twice due to certain unknown causes, firstly, to the deeper parts of the original tail, affecting its vertebral column and severing it completely, and thus producing a median regenerated tail, and, secondly, to the muscular part of the regenerated tail thus produced on its both sides: under the latter circumstances two accessory muscular lobes have developed.

Here I wish to express my indebtedness to Professor B. K. Das, D. Sc., for his constant guidance, invaluable suggestions and kind criticisms. My thanks are also due to Master Ajit Kumar Sarkar for the gift of the specimen.

EXPLANATION OF PLATE.

- Fig. 1. Photograph of the dorsal view of *Hemidactylus flaviviridis*, Rüppel, with a trifid tail. Specimen B.
 „ 2. Photograph of the dorsal view of *Gecko verticillatus*, Laurenti, with a triple tail produced artificially.

LIST OF ABBREVIATIONS USED.

B. S. T.	... Unsegmented base of the original tail.
C. R. T.	... Common regenerated trunk.
L. L. b.	... Left lateral branch or accessory lateral tail.
Med. br.	... Median branch of the trifid tail.
M. V. S.	... Mid-ventral row of scales.
R. L. b.	... Right lateral branch or accessory lateral tail.
S ₁ -S ₅ Segments of the portion of the original tail left intact.

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¹ Tornier (7) has shown that more than one cartilaginous tube may also extend inside a single accessory tail, if two or more neighbouring vertebrae be injured.

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OBITUARY

MISS JOAN PROCTER

(From the 'Times', September 21st, 1931.)

We regret to announce that Miss Joan Beauchamp Procter, D.Sc., F.L.S. F.Z.S., died yesterday after a prolonged period of illness at the age of 34.

Miss Procter was born in London on August 5, 1897, the younger daughter of Joseph and Elizabeth Procter, grand-daughter of Thomas Procter, of The Hoo, Great Gaddesdon, a Hertfordshire squire and of William Brockbank, a wealthy Quaker iron merchant of Manchester, a friend and patron of the pre-Raphaelite painters, and a proficient amateur in botany and geology. Joan was fragile and delicate from birth, and probably the only time in her life when she was physically happy was during six months spent in Switzerland in her twelfth year, when she gave herself up to botany, dancing and reckless tobogganing. Her education at St. Paul's School for Girls was much interrupted by illness, but she was recognized as a student of resolute will-power and brilliant ability. Her health made it necessary to give up her intention of going to Cambridge, but an opening congenial with her natural gifts presented itself.

From her earliest childhood she was devoted to all living creatures, but specially to reptiles and amphibians. She knew the haunts and the habits of all the British species, and had tamed and kept most of them in homes of her own devising. As a small child she had rejected dolls for a large green Dalmatian lizard, which travelled everywhere with her and sat at table beside her at meals. While still a small school girl she had gone to Dr. G. A. Boulenger, Keeper of Reptiles and Fishes at the British Museum, to ask him some question about the structure of a reptile, and he, recognizing that she was a naturalist by disposition, had helped and encouraged her and continued to take an interest in her. In 1917 when her Cambridge ambition had to be given up, Dr. Boulenger invited her to assist him at the Museum. From 1917 to 1920, she worked with him, and on his retirement in 1920 until 1923, she was in entire charge of the collections of Reptilia and Batrachia. During that time Miss Procter acquired a wide knowledge of her subject, and was the author of a series of original papers which established her reputation in the museums of the world. (She contributed various papers on the Reptiles of Mesopotamia and Persia to the *Journal of the Bombay Natural History Society*.)

In 1923 Dr. Chalmers Mitchell, the Secretary of the Zoological Society, who knew her artistic and technical ability from the models she had made for the show cases in the Natural History Museum, and from the surgical splints she had made for one of the War

*Editor's Note.

hospitals, invited her to assist Mr. E. G. Boulenger in designing and constructing the rockwork and backgrounds in the New Aquarium, a task which she accomplished with brilliant success. When the Aquarium was completed Mr. Boulenger became its director, and the council appointed Miss Procter to succeed him as Curator of Reptiles and Amphibia. No appointment could have been more successful. Through her acquaintance with those interested in reptiles in almost every part of the world, Miss Procter rapidly increased the collection. Her knowledge of the habits of her charges and her power of close and sympathetic observation led to many improvements in their health and comfort. She followed the work of the Society's pathologists in the *post-mortem* room, and was soon able to recognize the earliest traces of diseases and to devise appropriate treatment. She became an expert surgeon, excising tumours, dressing sores, and cleaning out and plugging abscesses, and more than one distinguished surgeon has watched her with amazement and admiration operating on the mouth or the eye of a cobra or rattlesnake with apparatus of her own devising.

The old Reptile House was unsatisfactory in many respects, and when the Council of the Society found it financially possible to construct a new one Miss Procter planned every detail from the general lay-out to the drains, electrical heating, and decorative backgrounds. The architects, contractors, electricians and decorators had a rough time until they realized that the positions of drain-plugs, electric heaters in rocks, or shelves for the store of anti-venomous sera had been fixed with a purpose and could not be changed without consultation. The house when completed won universal admiration from visitors, and its technical efficiency has set a new level in the possibilities of keeping reptiles in captivity.

Physically Miss Procter was excessively fragile, and for many years she seldom passed 24 hours without severe pain. A series of severe internal operations had prolonged her life, but had left her in a condition which only a resolute will made less than complete invalidism. From time to time, but with increasing frequency latterly, she had prostrating illnesses, but when it was physically possible she went daily to the Reptile House in an electric bath-chair, passing the intervening periods in bed. At the worst she had daily reports by telephone from the Reptile House to her bedroom, and daily visits from her colleagues and subordinates. In between her bouts of pain she was gay, witty, and thoughtful for every one. All who knew her personally were devoted to her, and those who knew her work recognized her extreme ability. The best likeness of her was a marble bust by G. Alexander exhibited in the Royal Academy this year. It has been purchased for presentation to the Zoological Society.

REVIEWS.

1. SHORT HISTORY OF THE CEYLON GAME AND FAUNA PRESERVATION SOCIETY.—By A. C. Tutein Nolthenius, F.Z.S., 1894-1931.

In this 'Short History of the Ceylon Game and Fauna Protection Society', compiled and edited by Mr. A. C. Tutein-Nolthenius, F.Z.S., and covering the period 1894 to 1931, we are given 'The Story of the Society' which 'is that of a long-sustained fight to gain from Government the indispensable protection without which the Game and large Fauna of the Island would have been almost, if not altogether, exterminated long before our time.'

The statistics and other information contained in this booklet of 64 pages (with six illustrations) show very clearly that had it not been for the influence of the Society and its Members, the sambur and spotted deer, and probably the buffalo also, were doomed to extinction.

In a most interesting Report (1907) on 'The Wanton Destruction of Game in Ceylon' (which is reproduced in full) by Mr. Harry Storey—7 years Honorary Secretary and 11 years, Chairman of the Society—figures are given which show that during the eight years 1894 to 1901, there was a *yearly* slaughter of 65,883 spotted deer and 9,930 sambur; and in 1902, Mr. Thos. Farr calculated that for the previous two years 69,328 stags 'and I will not attempt to calculate the number of hinds' were killed.

'It is the one great ambition of every adult male' says Mr. Storey, 'to possess a gun, and it may be taken for granted that nine out of every ten men in every village in Ceylon, near which any sort or kind of bird or beast can be shot, possess and use guns'. No restriction of any sort or kind is placed by Government on the possession of firearms by anyone in Ceylon.

From this state of affairs in 1907, and other difficulties stated in the same Report, it can be imagined that the Society had indeed an up-hill fight to get anything done; and indeed counsels of despair almost prevailed in the year 1912, for at a General Meeting held in April of that year 'the closing down of the Society altogether was considered'. Fortunate it was for the future of the Wild Life of the Island that the Meeting was prevailed upon by the Chairman, Lieut.-Col. Gordon Reeves 'to carry on for two or three years more and see how things went'. In that year Mr. Harry Storey was Honorary Secretary, and for the following ten years he was Chairman; so the Society struggled on.

The Yala Sanctuary was initiated in February 1899, and in 1901 it was reported that deer had largely increased; while in 1904 it was reported to be an unqualified success. In 1918 this Sanctuary was reported as 'not overcrowded', but in 1920 it was found necessary to take steps to thin out the number of animals by driving some of them into the reserves; and in 1927 the issue of special licenses for the purpose of thinning out the buffalo bulls and the stags was sanctioned. Thirty-seven bulls and 106 stags were shot.

From the history of the Yala Sanctuary, it is evident that such areas should not be too long maintained, but should be thrown open and a fresh area declared.

In 1910 there were two Sanctuaries aggregating 367 square miles (238,880 acres), and at the present time, there are three Sanctuaries which aggregate 275,000 acres.

In the matter of guns it is stated that in 1910 there were 47,407 weapons licensed, the holders of which had but 523 licenses to shoot game. 'An utter farce' indeed, which still continues as in 1929, the weapons were 66,936 and the game licenses only 836.

Guns and rifles imported into Ceylon for the five years 1922-1927 numbered 20,491 (S. B. guns 16,294, D. B. guns 3,068, rifles 1,129) a *yearly average* of 3,415 imported weapons; and with these came a yearly average of $1\frac{1}{2}$ million loaded cartridges. Poor birds and beasts, they have indeed a hard struggle for existence.

The remark of your reviewer on these figures is that as the people appear to want weapons for purposes of display only (being adequately protected from external enemies by the British Government), the number of licensed weapons might reasonably be reduced to—say—936 (100 more than the apparent sporting requirements) and the remaining 66,000 unnecessary weapons called in. Why not?

Similar figures for India would be very interesting. It is notorious that crop protection weapons are used for shooting in and out of season in neighbouring and distant jungles, and but few shots are ever fired on the land of the license holder. All the 'gun' noise sufficient for keeping animals from the crops can be made by means of the pole, pestle, and detonator method in use in the few localities where the people do not possess firearms. But all this is by the way.

Despite all the efforts of the Society during 37 years we read that the Wanderoo Monkey—of which a thumb-nail sketch is in the margin of the booklet—and the Rock, or Giant Squirrel, are still unprotected; and Ceylon seems to have been unfortunate in its governors as regards Game Protection, the only one who is favourably mentioned during all these struggling years being Sir Henry McCallum, G. C. M. G. etc., under whose auspices (1908), the all important Dried Meat Ordinance became law. It was mainly due to the untiring efforts of Mr. Harry Storey, 'The Doyen of the Game Preservation Society', that this Ordinance, without which all else was of little avail, became an accomplished fact. His portrait is the first in the book.

Following on this came the Game Ordinance (No. 1 of 1909) and, for the first time since the institution of the Society the object it had been striving for, viz., *Protection*—seemed likely to be attained.

But one thing remained—the proper enforcement of these Ordinances. That is the whole crux of the matter. It is especially difficult without the active co-operation of Government to enforce laws affecting animal life: witness the Wild Birds and Animals Protection Act of India which is by all accounts pretty well inoperative.

It has been recently urged in the public Press in India that unless action is now taken in the matter of preservation of the larger fauna of the country, it will soon be too late. That this is so those of us who are in a position to find out by visiting forests in various parts of the land know only too well; but without the active and continuous support of Government by means of suitable laws *properly enforced* all will be but useless endeavour. Probably at the present time the answer of the Indian Government would be that of the Ceylon Government in reply to urgent representations of the Society for effective action in 1907: 'Our Game Laws are quite efficient, *but* we regret we have not the power to enforce them!'

While the practically unlimited possession of arms in India continues, it is but little that can be done except in the Reserved Forests of the Forest Department. And if the policy of hindrance which seems to be gaining ground in one part of one of the Provinces continues, then the animals of even the Reserved Forests are doomed; for it can only be productive of good from every point of view that the right sort of sportsmen be encouraged and afforded every assistance to obtain shooting blocks. The more the shooting blocks are occupied the greater is the check on the destruction of game.

Rinderpest is mentioned as having caused much loss among the buffalo, sambar and pig, but the spotted deer were not affected by the disease. It would be interesting to have authoritative information as to whether this animal has been similarly immune in India.

The History contains an extremely interesting article (1910) by Mr. Thos. Farr on 'The Inflorescence of the Nilu (*Strobilanthes*)' which will be of much interest to dwellers on the Nilgiri Hills. With this article is reproduced a portrait of Mr. Farr, a true sportsman and lover of wild life, who was for some ten years the Honorary Secretary of the Society and did much in its early days for the Preservation of Game in Ceylon.

Of Mr. G. M. Crabbe who was for some 17 years either Chairman or Honorary Secretary, and is now a Life Member of the Society, and who was one of the first to lay aside the rifle in favour of the camera, a portrait is given; also one of Mr. Henry Englebracht, 'an irreconcilable Boer prisoner' who was in charge of, and did so much for the Yala Sanctuary during the years 1907-1928. In that last year he died and the grateful Society placed a memorial on his grave at Hambanteta.

There is of course much that remains to be done, for in matters affecting the protection of animal life, the work can never be even relaxed. That this is so is clear from extracts given of a lengthy Memorandum sent to the Colonial Secretary in January 1929 in which, among many matters, it was pointed out that if the present rate of destruction of wild life is to continue a number of useful and beautiful species will be exterminated, and that within a few years

the animal and bird life in general will be seriously depleted; that the Laws relating to game protection, gun licenses, and provision of Sanctuaries should be revised; and that a Government Department for the conservation and/or control of game and wild life should be established immediately. And there the matter rests, and, judging from past and present history, is likely to rest for many a weary period of years.

Ceylon is a Buddhist country and one of the principal tenets of the Buddhist religion is 'Kill not, lest ye slay the meanest thing upon the upward way'; so perhaps the 66,000 unnecessary guns will be withdrawn, perhaps not.

Mr. Tutein-Nolthenius closes the History, which he has compiled with so much labour, with a plea for establishment of a National Park; for, as he points out, 'A Reserve or Sanctuary is proclaimed by Government in the Government Gazette, *but*—in the same manner as it can be proclaimed it can also be unproclaimed, and done away with entirely, either by the same or by another Government. A National Park is Permanent for ever, Permanent by legislation, vested in Public Trust, a National Public Property, a property to be interested in and to be proud of'.

The thanks of the members of the Society, and of the public of Ceylon in general, are due to the Compiler of this History who undertook the writing of it as a labour of love in order to answer the question frequently asked 'What does the Game and Fauna Protection Society do—what has it done in the past?'

This he has amply shown, as also what is required in the future which can be concisely described as Game and Wild Life Department; the withdrawal of all unnecessary guns; the establishment of National Parks.

R. W. B.

2. BUTTERFLIES OF LAHORE.—By D. R. Puri, Punjab University.

My attention has been drawn to a somewhat extraordinary paper on the 'Butterflies of Lahore' published by the Department of Zoology of the Punjab University. The author, Mr. D. R. Puri, appears to have made a collection of butterflies in Lahore during the summer of 1925, many members of which he has failed to identify correctly. The paper is a pretentious one, containing long lists of unnecessary references and some elementary information regarding mimicry and protective resemblance, which the author incorrectly imagines to be original. A not inconsiderable expenditure has been incurred upon the production of four coloured plates.

Of the 57 species listed the four following can, under no circumstances, appertain to the fauna of Lahore: viz., *Aporia soracte* and *Ypthima narede*, Himalayan insects not occurring below 5,000 feet: *Argynnis aglaia*, a European butterfly which only reaches the Indian Empire in Chitral and the countries nearby, flying at over 6,000 feet: *Araschnia levana*, also a European butterfly, which does not even occur in the near neighbourhood of the Indian Empire.

A number of the other species recorded are most unlikely to have been obtained in Lahore and no serious collector could accept them without verification by himself or by an accepted authority.

To collectors, who wish to know what butterflies can be obtained in Lahore, reference is invited to a paper on the subject that appeared on page 136 of vol. xxv of the *Journal of the Bombay Natural History Society*. The author, Mr. G. W. de Rhe Philippe, O.B.E., is a well-known collector, and his results were based on four years' collecting.

W. H. E.

November 2, 1931

3. P. R. AWATI, B.A., D.I.C., I.E.S., and H. S. RAI, M.Sc.—*Ostrea cucullata*. The Bombay Oyster, xi, 107, 51 figs. Lucknow, Methodist Publishing House, 1931. (Rs. 2-8).

The collection of the Indian Zoological Memoirs on Indian Animal Types edited by Dr. K. N. Bahl and started by him with the extremely interesting study on *Pheretima* has been enriched by a new Memoir on the Bombay Oyster.

Already the very idea of providing Indian students and workers with typical collections, such as their colleagues in other countries enjoy, deserves every encouragement; but we are glad to add that considering the work of Bahl, of E. M. Thillayampalam (on *Scoliodon*) and this one of Awati and Rai, the realization has been so far entirely successful and praiseworthy.

The work which occupies our attention is absolutely well done. It is thorough and clear. It not only realizes its purpose, within the limits of the collection, but it also hints at interesting problems which claim further treatment. This is always the immediate result of direct observation and first-hand work: and we should like to urge Messrs. Awati and Rai to let us have the benefit of their studies on such interesting questions as the *symbiosis* or *parasitism* of *Pinnotheres*, the organogenesis, and the sex changes, which have so much attracted the attention of research workers in the case of European oyster, and other physiological problems, which apparently in the mind of the authors would have encumbered the clarity and fluency of the Monograph.

May we be allowed to remark that the branchial cavities should perhaps better be called inhalant and exhalant chambers.

The book like the others of the collection is well presented and amply illustrated.

And we are glad to see that, thanks to the painstaking efforts of Awati and Rai our *Ostrea cucullata* is no longer a poor relative of the fortunate *O. edulis*.

G. P. de B.

4. W. O. JAMES, B. SC., PH.D., D. Phil.—An Introduction to Plant Physiology. i-viii+259. Oxford, at the Clarendon Press, 1931. Price 7 sh. 6d. net.

The author states in his Preface that the book is written for readers of senior school or junior university status. His main intention was to give a balanced account of the more elementary aspects of plant physiology. He has not neglected recent research but has made use of it only as far as general principles are concerned. Of controversial matter the student will find very little. Instead he is given a sound general account of elementary physiology which is apt to create a keen interest in the beginner. The treatment of the subject is excellent. After a short and clear exposition of the point under treatment in each chapter, the experimental work is set out in great detail. This is an admirable feature of the book as everybody will admit who has experience of students' practical work and who knows how important are all those little hints without which the experiment so often fails to be a success. At the same time not many claims are made on the laboratory and no special apparatus of an elaborate kind is generally required. The illustrations, which are mostly original, are exceptionally good and clear.

Though the book is primarily concerned with things going on inside the plants themselves, the author constantly draws attention to the ways in which these happenings depend on circumstances outside, i.e., he always takes environment into account, not making an artificial separation between internal and external events.

E. B.

5. A BOOK OF MAN-EATERS.—By Brigadier-General R. G. Burton. 284 pages, 17 illustrations. Published by Hutchinson & Co. Rs. 12-6-0.

In his introduction to this book the author explains that it is for the most part a record of the experiences of many sportsmen and others; for it is not possible for any one man to come into contact with more than a few man-killing carnivorous beasts. He also acknowledges his indebtedness for material to the *Journal of the Bombay Natural History Society*, which he describes as a mine of valuable information, which indeed it is.

While, as the author indicates, the book deals with men, beasts, and reptiles, which kill and eat human beings, and perforce contains many thrilling and some gruesome stories; it is also designed to be a Natural History of Man-eaters, and in this respect some account is given of the distribution, habits, and character of wild beasts and methods of hunting them. So, in the course of development of the book, the reader is afforded considerable knowledge as to the nature of particular animals and can from this appreciate why they taken to preying on human beings.

In discussing the question of fear of man in wild animals the author concludes that such fear, when present, is due to acquired experience. That is no

doubt the case, for most wild creatures, when accustomed to seeing human beings, allow a very approach. There is no such thing in Nature as instinctive fear of human beings.

Those readers of the book who have practical knowledge of wild beasts and their ways will be interested in the remarks and observations on the question of the power of scent in the *Felidæ*.

At page 98 it is remarked as to the power of scent of the lion and tiger that further investigation is desirable. 'Sir Alfred Pease is quoted as being of opinion that the *Felidæ* have not a 'hound nose' but a 'winding nose'. No doubt this view is correct. When in the Pidoung Game Sanctuary last year the Game Warden showed the writer the place where he and the Chief Conservator watched a tiger walking in the open at right angles to the wind which was blowing from them. When he arrived at the place where the scent was carried to him, he at once bounded away with a grunt of alarm, not even looking to see where were the human beings whose presence was borne to him on the breeze.

That was a clear case of the ability of a tiger to scent human beings at a distance of about sixty yards. One knows that for panthers it is possible to sit on the ground to watch over a kill without being detected; but to do so for tiger is not possible. One sportsman who thought otherwise was detected by the tiger coming to his kill and was fortunate in recovering from the wounds he received.

It is probable that the *Felidæ* have sufficient 'winding nose' to be able to detect the presence of game for some little distance. What that distance is, has yet to be ascertained.

The author is mistaken in supposing that the female panther which mauled him was over nine stone in weight. It is not many male panthers which attain that weight and probably not one female in ten thousand will exceed one hundred pounds. Eighty pounds is the weight of a large female of the species.

As to hyaenas the author is not able to assert that these beasts will kill and eat adult human beings; but cases do occur and the writer shot a female hyaena in Central India which had killed and eaten two women and a boy of twelve. She had cubs and was no doubt unable to find food for them.

Of wolves, much that is interesting is related, as also of wolf, children and were-wolves. Of crocodiles, alligators, and sharks, there are gruesome stories.

The book has a complete index. The name of a wandering tribe of gipsies in India is given as 'Brinjara': 'Banjara' is the pronunciation of the people, and is the more correct spelling of the word.

The illustrations, most of them reproductions from photographs, are good.

The author's style of writing is straight forward and easy, and the book will find many readers.

R. W. B

MISCELLANEOUS NOTES

I. THE OCCURRENCE OF THE FLYING-FOX (*PTEROPUS GIGANTEUS*) IN THE PUNJAB.

1. Very numerous during the mango season throughout Gurdaspur District, Punjab.
2. Numerous while the guava trees were in fruit.
3. Few about in early September. Never seen after the 19th September.
4. No resting places discovered in the plains of Gurdaspur District, but Flying Foxes were gradually traced to Kotla, which is 30 miles from Pathankote on the Kangra Valley road. Gurdaspur is 23 miles from Pathankote. It therefore appears that these creatures travel long distances daily.

GURDASPUR,
26th October 1931.

C. BREADON,
District Engineer.

There was some correspondence in the *Civil and Military Gazette* a few months ago regarding the distribution of Flying Foxes in the Punjab. Blanford in his *Mammalia* states that they are not known to occur in the Punjab and that they are not found in the Himalayas except at the base as a visitor from the plains. Presumably changed conditions in the Punjab since Blanford's time, improvements in irrigation and the extension of horticulture have provided conditions which enabled the Flying Fox to establish itself in this Province. Writing in this connection Lt.-Col. J. E. M. Boyd says: "During the past 20 years I have frequently seen them at Ferozepore, where they come in when the fruit of the *Pipul* is ripe and also at Pathankote, Gurdaspur District. This year (1931) Flying Foxes have been seen in large numbers flying round the fruit trees at the British Military Hospital, Dalhousie." Recently the Society received a specimen of a Flying Fox from Mr. A. E. Jones, Simla. It is an example of the Nepal race *P. giganteus leucocephalus*. — Eds.]

II.—NUMBER OF CUBS IN A TIGER'S LITTER.

During December, 1930, Mr. Walter Draper of our Factory went out in his car for a jaunt in the country. Being a very keen shikari, he always takes his guns with him. About 30 miles out of Jubbulpore, he came across a likely looking spot and descended to try his luck with a view to securing some game birds for the 'pot'. On leaving the car, he and his friend walked about a couple of hundred yards from the main road, where they halted, and while discussing the best pathway to take, they heard the unmistakable sound of a large animal treading on dried leaves. The jungle here being pretty thick, it was difficult to get a clear view of the country round about. On turning round in the direction from which the sound originated, Mr. Draper caught a glimpse of the head and shoulders of a tigress as she passed broadside on. Following up the direction she was making for, he noticed an opening in the thick scrub, and realising she would soon come into view, he

awaited his opportunity, which took but a few seconds to materialise. He at once fired, knocking her completely out of action in the one shot, the bullet having struck the base of her neck and lodged itself in the ribs. The skin of the animal was not removed till four hours after she was killed, when six cubs were taken out; all very much alive and kicking. They proved to be three males and three females, all perfect specimens in every detail including claws, etc. All died within an hour of removal. Presumably they would have been born within a few hours, and, had the proper measures been adopted to rear them, I have every reason to believe they could have been saved. It would be interesting to learn if any member has heard of such another case, i.e., seven tigers in one shot. The measurement of the skin is 10 feet 8 inches.

GUN CARRIAGE FACTORY,

ARTHUR H. BERRIFF.

JUBBULPORE,

17th July, 1931.

[The Hon. J. W. Best also mentions a case of seven foetuses taken from a tigress. Six, four and five have been noted, but two or three appear to be the usual number.—Eds.]

III.—OCCURRENCE OF THE PANTHER IN THE SIND DESERT

Some time back, I read in the *Times of India* that a *tiger* had been killed by villagers in the neighbourhood of Umarmkōt in the Thar and Parkar District of Sind. As it seemed obvious that a panther was meant, I wrote to the Collector, Rao Bahadur Jagatsing, for details. His reply confirms the fact that a panther was killed on or about 20th February 1931 at a place near Chhōr, 6 miles from Khokhrapur railway station. The villagers tackled the animal with hatchets and two of them were mauled in the struggle. The Mukhtiarkar, who furnished a graphic account of the incident to the Collector, says the animal measured '3 feet tall, 4½ feet long and 3½ feet in girth' (?) It is believed to have strayed in from the adjoining Jodhpur territory, and, according to the report, had destroyed 'two heads of bovine' in the Khipro taluka before it was killed.

The appearance of a panther on the edge of the Sind Desert seems an occurrence unusual enough to be worthy of being put on record.

ALIBAG, KOLABA DISTRICT,

HAMID A. ALI,

2nd August, 1931.

I. C. S.

IV.—DO LIONS STILL EXIST IN PERSIA?

(From the *Field*)

There is a general belief that the lion is now extinct in Persia and in the absence of any evidence to the contrary, one might, after a space of a number of years, come to the reasonable conclusion that such is the case.

In one of his books, Sir Percy Sykes somewhere mentions having seen the carcase of a lion floating down the Karun River. That must have been a number of years before the War. Also in

Amurath to Amurath, the late Miss Gertrude Bell mentions a pair of live lions which she saw in Baghdad, and which had been caught in the swamps of Amarah.

In the course of two prolonged motor journeys through Persia during the past five years, the writer made numerous enquiries without being able to obtain any definite information on the subject. Those Persians who might have known something about it all declared that they had never heard of a lion having been seen for many years.

There was a reported case of the skin of a lion having been brought into Barfarush by a native trapper. An Englishman who saw the skin said it looked like that of a lioness, but he could not be certain about it, and the skin was purchased as a curiosity by the Soviet Consul.

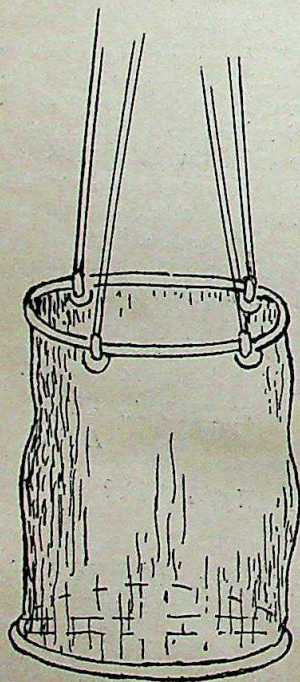
Last year, however, fresh light was thrown on the subject by another Englishman, an engineer on the railway construction work in south-west Persia. According to this gentleman, a party of American engineers had come out to inspect the work which at that time was in progress in the wild and mountainous region around Dizful. Some of the party strolled out one morning to look at the line, and they came across a pair of full-grown lions. The animals showed no fear, and the party being without any weapons beat a retreat back to camp. The lions were not seen again.

The above would seem to be definite evidence that lions do still exist in Persia, and if one pair were seen, the presumption is that there may be many more in these wild hilly tracts of the south-west of Persia.

RONALD SINCLAIR, F.R.G.S.
LONDON, S.W. 7.

V.—A USEFUL TYPE OF MACHAN.

(With a diagram.)



The accompanying sketch is of a *machan* I have used with great success for years. Its good qualities are: (1) it can be put up very quickly by one coolie, with hardly any noise; (2) the shikari if dissatisfied with his post can change to a higher or lower or more open position by moving the ropes which fasten the bag; (3) any movements in the bag are noiseless. The mouth of the bag should be constructed with an iron or strong bamboo ring. All the iron work should be covered with sacking, lest the gun barrel, striking the ring, sound a note of warning to any game that may be near.

In moving the bag, only one rope should be moved at a time. The supporting ropes should be tested before being tied to the ring. The wood flooring in the bag should be strong and covered with sacking so as to silence any foot movements.

DYKE, ETHORPE CRESCENT,
GERRARD'S CROSS, BUCKS,
September 1, 1931.

W. FORSYTH.

VI.—DO WILD DOGS HUNT AND KILL BY NIGHT?

I believe that wild dogs do not usually hunt by night. They may do so under stress of hunger or on nights when there is a good moon. I am of opinion that their powers of sight would be less keen by night. Wild dogs follow deer calls but whether they do so by night is a doubtful question. I should be glad to hear the views of other sportsmen.

August 15, 1931.

RAMANUJ OF SURGUJA.

VII.—THE MALAY BEAR.

(With a photo.)

In vol. xxxiv, No. 3, you publish an illustration of a Malay Bear (*Ursus malayanus*). I enclose another photograph of one shot by a sepoy of the 4th Assam Rifles in the Manipur State, about longitude 93°25' and latitude 25°7'. It was an old female, with broken teeth. Unfortunately, I did not take the measurements, but she was certainly less than 4½ feet long.

This bear is distributed throughout the hills of the State, but is not common. During the seven years I was on foreign service in the State (1910-17), I paid rewards for the destruction of 1,389 bears, and, speaking from memory, I should say that not more than 1 per cent. of these were of this species.

During the three years I was in Nowgong (Assam), which is slightly further west than the Manipur State, I only came across one Malay Bear. Some Mikirs brought in what they claimed



to be a 'black tiger,' for the reward. This proved to be a full-grown Malay Bear. But my classification of the animal as a bear was received with polite derision by the Mikirs, who said that they were perfectly familiar with the bear and that this was certainly not one. Their familiarity with the bear is undoubted as there are few Mikir villages which do not contain at least one unfortunate who has been mauled by a bear. But their claim that it was a tiger was largely influenced by the fact that the reward for a bear was only Rs. 5, whereas the reward for a half-grown tiger was Rs. 12-8. They stoutly refused to be convinced, until the argument was closed by my Head Clerk, with the words, 'The Sahib says it is a bear, so it is a bear.'

THE RESIDENCY,
IMPHAL MANIPUR STATE,
19th July, 1931.

J. C. HIGGINS,
I. C. S.

VIII.—BLACK FOUR-HORNED ANTELOPE (*TETRACEROS QUADRICORNIS*.)

A melanistic example of the Four-horned Antelope was shot by Maharaj Kumar Chandikeshwar Saran Singh Deo, second son of the Maharaja of Surguja. The antelope had the colouring of an adult Black Buck. It was shot 14 miles west from the capital town Ambikapur at about twilight. There were evidently a pair and as its little horn could not be distinguished in the bad light, it was fired at and killed. Unfortunately it proved to be a female, but its mate had the normal colouring of the species. I regret that I was unable to secure a photo of this unique specimen.

SURGUJA STATE,
CENTRAL PROVINCES.

RAMANUJ OF SURGUJA.

IX.—ROGUE ELEPHANTS IN THE KHASI HILLS.

In the Khasi and Jaintia Hills, there are always one or two solitary 'rogue' elephants and not long ago in the Jirang State there were several of them. The local cultivators suffered heavily from the unwelcome and repeated visits of these animals. About the close of the last year two such dangerous 'rogues' were proclaimed and one of them was shot by me. This animal had lost its tail with the exception of a short stump left to indicate its position. On its left side alone, as it laid down dead, I counted some seventeen partially-healed-up wounds, which swelled out about $1\frac{1}{2}$ " to 2" from the body. On opening out a few of them a thick and sticky matter came out. These were no doubt the marks left on him of the shots dealt by the cultivators during his visits to their cultivations. On the

inner side of its right foreleg, there was a big abscess about a foot in diameter with plenty of maggots in it. It is not understood as to how it got that wound though undoubtedly it was the one which nettled its temper most.

This animal during some months previous to its death had become a perfect terror to the neighbourhood, chasing people, robbing paddy from the fields and barns in the Umsaw and other adjacent villages, and, on the evening previous to its death, went close to the village of Mawlein where it attacked a 'Khuti-walla's' shed, drove out the buffaloes and their keepers, and killed one calf by goring it with its tusk. The rogue had a good drink of whey kept in a wooden barrel and upset the barrel when it no longer wanted it. Then it went to have a taste of *ghee* kept in kerosine oil tins but finding it not to its liking knocked down the tins and their contents and, before leaving the place, pulled down the shed and trampled over it.

On the following day, I tracked this animal from the last scene of his depredations and within a mile in the forest suddenly heard the shrill alarm raised by it. By the time I knew whence the sound proceeded, the big rogue was advancing towards me with the speed of a locomotive engine. Knowing that elephants, though they have a very keen sense of hearing and smell, have got a very poor eye-sight, I stood still (my guides had already deserted me) until the animal was only about 30 yards or so from me, then I moved towards its right side, about ten yards from its direct line of advance. The animal stopped for a moment when it reached the spot where he scented or knew that I was, and during that short interval I put in one temple shot which brought him right down and there ended the career of one of the troublesome rogues of that locality.

The animal measured 10' 8" from the shoulder and the circumference of its fore foot was 5' 3½". The length of the tusks was 5' 4", each; the girth at their thickest portion was 17¾" and both tipped the scale at 96 lbs.

SHILLONG, ASSAM,
17th July, 1931.

L. L. READE.

X.—THE MIGRATION OF THE PARADISE FLYCATCHER (*TCHITREA PARADISI*)

During the last two or three years a variety of articles in the *Journal* have made it very clear that our present knowledge of the migration of Indian birds is far from complete. The Bombay Natural History Society's ringing scheme has already done something, and will in the future undoubtedly do more, to increase our knowledge. But the number of species on which ringing can be practised is strictly limited, and some other method must also be adopted if we are ever to have anything like a complete knowledge of the movements of the smaller migrants.

In the past, observation on the migration of birds has largely been observation at certain specially favoured points. Observation of

this type has produced such books as Gatke's 'Heligoland', and Eagle Clarke's 'Studies in Bird Migration'. The information that has been obtained in that way is very valuable, but there is another method of approaching the subject which has the great advantage that it begins with the assumption that the problems of migration may differ considerably in different species. That method is to collect all possible records of migration, species by species. An illustration of that method is to be found in Mr. Hugh Whistler's article 'The Migration of the Pied Crested Cuckoo (*Clamator jacobinus*)'. (*J.B.N.H.S.*, vol. xxxiii, pp. 136 to 145).

The purposes of the present article are (1) to point out some of the contradictory statements that have been made about the migration of the Paradise Flycatcher (*Tchitrea paradisi*); (2) to record the small amount of information the writer has been able to record on the subject from his own observation; and (3) to endeavour to interest members of the Society in helping by their observations to clear up the status of this very familiar bird.

All that the *Fauna of British India* (Second Edition) has to say about the subject is—'The Paradise Flycatcher is a resident bird wherever found, but moves about locally in parts of its habitat, probably on account of food-conditions.' (*Fauna of British India: Birds*, vol. ii, p. 267). Similar statements are made in the '*Fauna*' about several other species, but, as no definition is given of the difference between 'migration' and 'local movement', they are not very helpful.

In '*Nests and Eggs of Indian Birds*', (Second Edition, vol. ii, pp. 22-26), it is stated that this species breeds 'Throughout the exterior ranges of the Himalayas up to an elevation of 5,500 feet: at any rate from Nepal to Afghanistan', also at Almora, Kotegurh, the Sutlej Valley, Sooltanpoor, and the Valley of the Beas, and Kashmir it is common.' Other places where, according to the same book, the species has been recorded as breeding, are the Doon, Terai, northern portions of Rohilkund and Oudh, wooded portions of Jhansi, Saugor, Nimar, Raipur, and 'doubtless other portions of the Central Provinces', also the Agrore Valley, Barreilly, Calcutta Botanical Gardens, Delhi, Murree, Kashmir, Rajputana, Baroda, Mysore and Ceylon.

Whistler states ('Popular Handbook of Indian Birds', pp. 99, 100):—'Very little is known of the status and habits of this common and widely-spread bird, but it is undoubtedly migratory to a large extent. In the North-Western Himalayas and Salt Range, it is a summer visitor, only arriving about March and April and departing about September: while in most of the Punjab it is only a passage migrant in those months. To Sind it is a scarce winter visitor; while in many localities it is undoubtedly a resident.'

Since the first and third of the above summaries are mutually contradictory, and the second, which does not in the main deal with migration, certainly does not support the first, it will be well to collect a number of observations on the bird in various districts.

Beginning from the north-west, Capt. R. H. Rattray, writing of the species at Kohat, states: 'This bird breeds here fairly plentifully'. (*J.B.N.H.S.*, vol. x, p. 628).

The following note on the status of the Paradise Flycatcher at Peshawar occurs in vol. xxxii of the *Journal* (p. 750): 'A few breed in the Valley, as Briggs found a female feeding three young in trees overhanging the Grand Trunk Road, eight miles east of Peshawar on June 20, 1923. It is, however, a passage migrant in spring and autumn. Briggs states that they pass through in large numbers, but appear to stop only one day. That day falls, as far as his observations go, between April 23 and 29 in the spring, and between September 19 and 29 in the autumn. The race has not been identified.'

In 'Notes on the Birds of Thandiani' (*J.B.N.H.S.*, vol. xviii, p. 290), Major H. A. F. Magrath states: 'On July 9, I saw a female Paradise Flycatcher hawking dragonflies near the waterfalls on the Sufed Pani stream above Kala Pani.' In July 1921, I saw an adult male of the species between the falls mentioned above and Thandiani. It was the only occasion on which I saw the species in that neighbourhood.

I have found the species breeding in considerable numbers near Murree, chiefly about 5,000 feet.

In Kashmir the Paradise Flycatcher is one of the most familiar birds in the summer.

Whistler states (*J.B.N.H.S.*, vol. xxviii, p. 997): 'Except for an adult male seen on April 6, no Paradise Flycatcher was seen until April 14. After that date the species was common about Srinagar till my departure and I saw several about the road on my downward journey.'

Referring also to Kashmir B. B. Osmaaten states (*J. B. N. H. S.*, vol. xxxi, p. 988) that the species is common in the Vale of Kashmir in summer, ascending the hills to about 6,000 feet; that it arrives about the middle of April, leaves about the middle of October, and breeds in May and June.

Whistler states that the species is common in the Kulu Valley up to a height of about 5,000 ft. adding: '...of course only as a summer visitor.'

Leaving the hills for the plains of the Punjab, we find that Dewar states that the species 'visits the Punjab in great numbers in summer for nesting purposes'; (*Indian Birds*, p. 124); and that 'in Lahore this species nests in considerable numbers along the well-wooded banks of the Ravi.'

The following is a quotation from 'A Contribution to the Ornithology of Delhi' (*J. B. N. H. S.*, vol. xxxi, p. 268), by S. Basil-Edwardes: '*Terpsiphone paradisi paradisi* (L) (The Indian Paradise Flycatcher). I did not see this species, and it had not arrived before I left Delhi. (Eggs taken by Bingham. Seven nests on May 27, and June 12.)'

F. Field, writing of the Gonda District, U. P., and referring to the breeding of the species, says:—'In forests and plains, but more common in forests. May, June.' (*J.B.N.H.S.*, vol. xxviii, p. 757.)

In an article entitled 'A Description of the Nests and Eggs of the Common Birds occurring in the Plains of the United Provinces', (*J. B. N. H. S.*, vol. xxix, p. 343), E. H. N. Gill states: 'During the winter months this attractive bird occurs in most districts and is

frequently met with in gardens and groves adjoining human dwellings. Unfortunately, the bulk seem to migrate in summer to the Sub-Himalayan tracts, but a great many remain behind and breed sparingly throughout the plains. I have found eggs as regularly in the Eastern as in the Western Districts.'

In the Ghazipur District of the U. P., the species appears to occur as a passage migrant and a summer visitor. Perhaps a rains visitor would be a better description, as they do not seem to be established till the middle of June. In 1930 all seemed to have left by September 17, but on October 3 and 13, single birds were seen, and a pair on October 17. This year (1931), from the middle of April till the middle of June, occasional birds were seen, often with a gap of several days when none were to be seen. Presumably these were passage migrants, as I believe those seen in October last year were.

In 'Birds of an Indian Garden' by T. Bainbridge Fletcher and C. M. Inglis, (p. 60), the following note on the species in Bihar occurs: 'In North Bihar,.....it arrives about the end of March and leaves at the end of October, not being noticed during the cold weather. It is fairly common locally in Bihar, but its distribution seems to be rather erratic: for example, I have never seen one at Pusa.'

In the neighbourhood of Mhow (Central India), the Paradise Flycatcher breeds in the Vindhya Hills, and occurs on the Malwa Plateau as a passage migrant. Whether it is resident in the Vindhya Hills or only a summer visitor I am uncertain, but I did not observe it there between October 12 and March 27.

Cunningham, in 'Some Indian Friends and Acquaintances,' (p. 123), says of this species:—'They are not very common inmates of gardens about Calcutta, but stray specimens may be met with at almost every time of the year, and, at the beginning of summer, small parties of them, apparently in quest of good sites for nests, often visit quiet areas, such as those afforded by the more secluded parts of the Botanic Gardens. Such parties include birds of both sexes, some of the males being in all the splendour of fully developed trains and mature black and white colouring, whilst others have trains of chestnut or are still feathered like the females. At all other times of the year it is very rare to see any but short-tailed, chestnut and black birds.'

'Eha' states ('The Common Birds of Bombay', p. 77 '.....everybody who has roamed about Matheran or Mahableshwar must be familiar with it, but I dare say some will be surprised to hear that it is a Bombay bird.....I believe that the Paradise Flycatcher only visits us for a short time during the cold season. I have never heard of its nest being found on this island.'

Lastly, Mr. George Brown includes this species in a list of birds seen on a trip from Pottuvil to Kumna, Ceylon, between April 10 and 21. (*J.B.N.H.S.*, vol. xxxiv, pp. 815 ff.)

From the above extracts it would appear that, far from being 'a resident bird wherever found', (*Fauna*), it is mainly, if not entirely, a migratory species. Its breeding area, however, does not seem to have been very clearly defined so far, and its winter quarters seem still more vague. In addition to this there are certain contradictions amongst the statements quoted above.

The species appears to breed through a large part of the Himalayas at comparatively low levels. Presumably all these records refer to the sub-species *leucogaster*. South of the Himalayas they breed sparingly in the N.-W.F.P., but are recorded only near Lahore in the Punjab. They have been recorded as breeding at Delhi, and are regular breeders in the United Provinces. As it is recorded as a summer visitor to parts of Bihar, it is fair to assume that it breeds there. 'Nests and eggs' records it as having bred in the Botanical Gardens, Calcutta, but Cunningham's references to the species appear to point it out as mainly a passage migrant at Calcutta. Further south it appears to breed in various parts of the hilly country of Central India. It is also reported as breeding in Rajputana, Baroda and Mysore.

Referring to the winter area of the species only two places are mentioned—Sind and Bombay. Whether 'Eha's' reference is meant to apply only to Bombay or whether it also applies to Mahableshwar and Matheran is uncertain.¹

The only contradictory statements that need to be mentioned here are those of Mr. Gill and myself. It would be interesting to know to what districts of the U. P. the former is referring. In the Ghazipur, Benares, and Azamgarh Districts, the Paradise Flycatcher certainly does not occur in the winter, and I have been told by reliable observers that the same is true of the Fyzabad District. What makes Mr. Gill's statement more surprising is that he spent some time in the Ghazipur District. Is it possible that in some years the species winters in the United Provinces and that in other years it does not?

In any case, enough has probably been said to prove that our present knowledge of the species is far from complete. If every member of the Bombay Natural History Society would note the status of the Paradise Flycatcher in his own area and send that information to someone capable of dealing with it, more might be learned of its movements. The same is true of many other familiar species, but the Paradise Flycatcher is a good bird to begin on, because it is so conspicuous that it cannot be overlooked. Unless someone better qualified is prepared to undertake the task of collating such information as may come to hand in that way, I am quite ready to do so myself, and shall be grateful to anyone who will correspond with me on the subject. One point to be noticed is that, although the distribution of the Paradise Flycatcher is given as the whole of India, there seems to be a great paucity of information from the south. A second point is that, although sub-specific identifications are useful, notes are also useful where the sub-species is doubtful, and that sub-specific identifications which are not supported by specimens are more likely

¹ 'Eha's' reference applies, we believe, to Bombay where the Paradise Flycatcher has been observed occasionally during the cold weather. It has been noted in Bandra, at the foot of Trombay and in the wooded portions of Salsette during this time of the year. In Matheran and Mahableshwar, the Paradise Flycatcher is common during the cold weather and less so during April, May, though young birds have been observed during the hot season.—Eds.

to increase than to clear up the present vagueness of our knowledge of the status of the species.

WESLEYAN MISSION,
GHAZIPUR, U. P.,
July, 1931.

F. S. BRIGGS.

XI.—SEX DIFFERENCES IN THE MIGRATION OF THE COMMON TEAL (*NETTION CRECA*)

It may interest you to know that while I was in Kashmir between January and February, 1930, I shot a considerable number of Common Teal. All of them with one exception were drakes. I believe that it has been noticed by other observers that the females of the Common Teal are in a large majority in early winter and later their places are taken almost entirely by drakes. This was certainly borne out by my observation.

PORTLAND PARK,
ALIPUR, CALCUTTA,
July 20, 1931.

M. D. N. WYATT.

[Differences in migration behaviour related to sex and age have frequently come under notice. Gatke from his observations of the movements of birds at Heligoland held that adult males tended to be later in migration than the females. His view seems to be supported by the observations of Mr. Wyatt and others in reference to the autumn migration of the Common Teal into India. The behaviour of migrating birds must vary in different species and no general rule can be laid down without further confirmation.—Eds.]

XII.—NOTES ON THE NESTING HABITS OF THE RED-VENTED BULBUL (*MOLPASTES CAFER*).

A pair of these birds built their nest and brought up three young just opposite the front door of a friend of mine, in the heart of the city. I. R. drew my attention to the nest, and we both watched the parent birds for a considerable time feeding their young. One interesting point resulted from our observations. It is a well-known fact that the nests of birds are seldom soiled by the excreta of the young. This cleanliness is generally attributed to the fact that the young either excrete in such a way so as to 'shoot' the excrements beyond the limits of the nest, a very common thing with the Birds of Prey, for example, or, the parent birds are responsible for cleaning the nest when leaving it after feeding the young. In the former case the excreta of the young is usually in a very liquid state, but in the latter the excreta is generally enveloped in a thin tenacious film which is not easily punctured. This facilitates its removal from the nest.

To return to the birds under observation, we noticed that in this case, at least, that each time the parents fed one of the young, they would immediately go round to the nether end and wait for it to excrete. It is well known that as soon as nestlings are fed, they excrete immediately after. In the present instance it was observed that each time the young excreted, the parent birds would take hold of the excreta as it emerged and swallow it. This procedure was repeated each time the young were fed. Here arises a question. Why should the parent birds swallow the excreta? In domestic animals, such as the dog and the cat, it is common knowledge that the mother eats the afterbirth and other secretions at the time of birth and later on cleans up both the excreta and the urine of the young. Is it possible that in such cases the reason for such a habit serves only as a means of keeping the nest or lair clean or, is it that there still remains in the excretions of the young a certain amount of undigested nourishment which helps also to nourish the parent? For at the time when animals are burdened with young, they appear to have little time for feeding themselves, being occupied the greater part of that time either in protecting or feeding the young. In the case of birds it seems as though the parents have little time to obtain a sufficient supply of food for themselves when they are burdened with young. The parent birds are seen going to and fro all day from the nest and one wonders what time they have to feed themselves. They can only bring one insect at a time, and young birds take a lot of feeding. Therefore it does seem possible that the parents do derive a certain amount of nourishment from the excreta of their young which is in all probability only partially digested.

Another point of interest is that though the nest was in a most exposed situation, these little birds were able to hold their own against the crows that infested the locality. No crows were permitted to come within a certain distance of the nest. If they did they were immediately attacked, the bulbuls' rapid movements were too much for the crows, forcing them to beat a hasty retreat. It seemed strange that despite the great difference in size, the crows would not make a stand to defend themselves but would only fly out of the area.

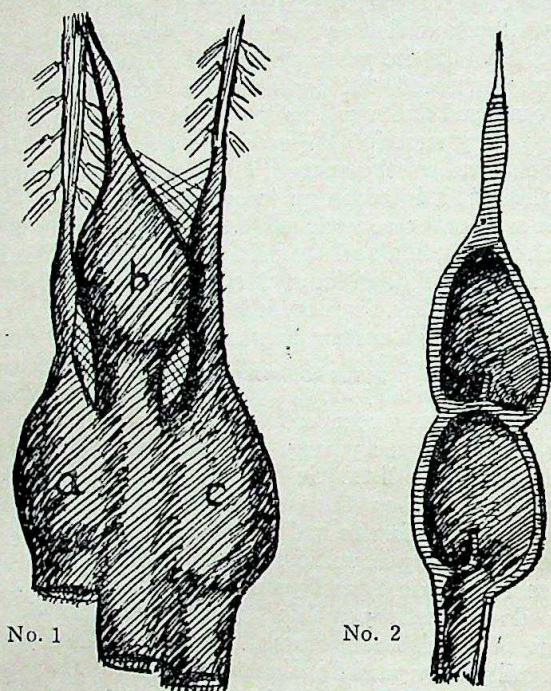
BOMBAY NATURAL HISTORY SOCIETY, C. McCANN, F.L.S.,
BOMBAY, Assistant Curator.
September 30, 1931.

XIII.—DOUBLE NESTS OF THE WEAVER BIRD (*PLOCEUS PHILIPPINUS*).

(With a diagram).

In *Miscellanea Zoologica Sumatrana*, lvii, Mr. J. C. Van der Meer Mohr in a note on the nesting habits of the Malay Weaver Finch (*Ploceus passerinus infortunatus*) describes examples of 'double nests'

of this bird secured by him in Sumatra. The writer illustrates three types of these peculiar nests—



1. A new complete nest built under and closing the entrance to the egg-chamber of an old nest, left over from the previous season.

2. Two nests built and woven together side by side.

3. Is a variation of No. 1—four nests 'storied' one above the other.

The note has drawn my attention to very similar nests built by the Indian Weaver Bird (*Ploceus philippinus*). These nests were collected at Indore and presented to the Society by Mr. Mears. The figures on page 682 give an indication of their structure:

No. 1 illustrates three connected nests, *a*, *b*, and *c*.

a and *b* are suspended from the same palm leaf; *a* from its extremity; *b* from about 1' higher; *c* from a neighbouring leaf. *a* is an incomplete nest without its entrance tube, its egg chamber is solidly interwoven with the entrance tube of *b*, while its upper portion is loosely attached. *b* is a complete nest. Its solid upper portion measures 10", the egg-chamber 7" and the entrance tube 16". *c* is a complete nest with a short entrance tube. Its egg-chamber and tube are closely woven to the entrance tube of *b* while the attachment of its upper portion is rudimentary. It will be seen that Nest No. 1, from Indore, corresponds to type 2 taken in Sumatra, *i.e.*, two nests joined side by side.

Nest No. 2 follows type 1 from Sumatra, *i.e.*, a complete nest built under and closing the entrance to an incomplete nest above it.

Whether these nests were the work of the same cock or not, it is impossible to say.

Mr. E. G. Herbert in his paper on the Nests and Eggs of Birds in Central Siam (*Journ. Siam Soc., Nat. Hist.*, vol. vi, 1923-1926), which Mr. Van der Meer Mohr quotes, also refers to 'double' nests of Weaver Birds observed by him—in this instance a new nest built under an old one.

Mr. Cripps writing on the nesting of the Eastern Baya (*Ploceus megarhynchus*), Hume's *Nests and Eggs of Indian Birds*, second edition, vol. ii, p. 119) says: 'I have on several occasions found a second nest commenced from the bottom of the tube of the old one, the upper nest being useless as the passage is closed up.' This peculiarity in the nest building of our Weaver Birds noted by many observers may perhaps offer a clue to the origin of the great communal nests of the Social Weaver Birds (*Philotherus socius*) of South Africa. These wonderful nests built of grass and twigs are composed of numerous separate chambers for housing individual families. The birds do not occupy the same compartments every year, but at the return of the breeding season build new nests under the old ones. Thus the aggregated mass increase in size and may contain more than one or two hundred separate chambers. From building separate nests these Weaver Birds may have passed to the stage of joining a few nests together and in course of time was thus evolved the present gigantic structure with its common roof and its component cubicles for the housing of a few hundred families. The material used, the site and the plan of construction adopted, the circumstances and conditions under which these birds built their nests and the effective protection they obtained being the factors which directed and favoured the intenser development of the social habit and the evolution of this particular type of nest architecture as the one most beneficial to the preservation and continuity of the species.

BOMBAY NATURAL HISTORY SOCIETY. S. H. PRATER, C.M.Z.S.
6 APOLLO STREET, *Curator.*
October 15, 1931.

XIV.—PLACE OF THE JAVA SPARROW (*MUNIA ORYZIVORA* L.) IN THE INDIAN AVIFAUNA.

Munia oryzivora (Linn.) attracts notice more as a cage-bird than one which, given its freedom, can thrive and readily acclimatise itself in other than its native habitat. The case of such liberated individuals is not unknown in the annals of Indian ornithology. The introduced species is looked upon as only an exotic form—an escape from the cage. Half a century ago, Blyth mentioned the occurrence of *Munia oryzivora* (Linn.) in the Mergui Province (Burma). Jerdon, Hume and Oates found the bird common enough and nesting wild near Madras. Legge recorded its acclimatisation in Ceylon. A species which had to its credit a record of successes in introducing and maintaining its hold in new situations and under varying circumstances in many parts of China, Japan, Siam, Cochin China, the

Malay Archipelago, Mauritius, the Zanzibar Coast and other localities, would naturally raise high hopes in the mind of Oates as regards its rapid multiplication in the jungles of British Burma. The problem arises what would *now* be the status of *Munia oryzivora* (Linn.) in relation to India's native avifauna? Will the success of its introduction or the extent at its present stage of its naturalisation in this country warrant its inclusion in the permanent list of the Indian avifauna? Oates who edited the first edition of *F.B.I. (Birds)* was merely content with an allusion to this bird in a foot-note. Apparently it was premature then to take for granted its Indian domicile. Almost half a century has since gone by. From published records during this period one finds hardly any light on its movements. A new edition of *F.B.I. (Birds)* has been called forth, and in it, unhappily for *Munia oryzivora* (Linn.), Mr. Stuart Baker has not a word to say, nay, he has thought fit to delete even the former foot-note of Oates. Has the bird then lost its foothold and failed completely in its effort to cope with Indian conditions? The bird 'appears to be acclimatised near Madras', writes Mr. W. E. Wait in 1925 in his *Manual of Birds of Ceylon*, though round Colombo it seems to him not quite as flourishing as in Legge's time. Very recently near Calcutta (10 miles to its north), I have under observation a colony of these Munias whose favourite resort is a shrubby situation composed of two or three trees embracing each other and overhanging the paddy-stacks put up in the compound of some villagers close to Agarpara railway station (Dist. 24-Parganas). These have not only food within easy reach but also cover and shelter from the hot sun and driving rain. Their hunting ground in the early morning is the surrounding paddy-fields (from which paddy and straw have been removed), where flocks of considerable size will descend and feed on fallen paddy. Their chirrups are now incessantly heard and enliven the country-side. They feed here till about 8 o'clock when they retire to their cover and roost, returning towards afternoon to search for paddy. Wary to a degree, they will, on the least suspicion of danger, hurry away to distant directions, some sheltering themselves in tree-tops and some in thickets and impenetrable reed-beds within *jheels*. Once I found while a bird-catcher spread his net to capture them, the birds on the paddy-fields would keep clear of the trap. Frightened birds while seeking cover among trees will so adjust themselves that one tries in vain to look for them in the self-same tree into which they slip into complete oblivion. Evidently these birds suffer little molestation from the local people, for they will allow me to watch them at close quarters. Great are their chances of persecution, as they are much sought after as cage-birds on account of their pretty colour and attractive qualities, and they enjoy hardly any protection under the legislation of the country. They are quite hardy birds and possessed, as they are, with powerful beaks and no inconsiderable power of flight, apparently run little risk of getting worsted in the struggle for existence. Sparrows will dare not bully them. Rather both will tolerate each other, roosting and feeding in each other's company. I have not yet been able to find out the nesting site of the Munias, but I suspect it lies within the belt of almost impenetrable reeds not far off from their

roosting place. The under-noted measurements are those of three specimens which I could manage, with the aid of a bird-catcher, to snare with bird-lime :—

Locality.	Date.	Wing.	Tail.	Tarsus.	Culmen.
Agarpara ...	30—1—31	67	47	19	18 mm.
Do. ...	31—1—31	66	46	18·5	17 mm.
Do. ...	1—2—31	69	47	19	17 mm.

So little is known about *Munia oryzivora* (L.) introduced into various parts of our country. There is no published record of its occurrence in Bengal. Yet the bird has had some success in its efforts to adjust itself to situations and circumstances unfamiliar to it. Will not this success claim for it a place among India's avifauna? The problem, fascinating as it is, admits of solution by closer observation and concerted effort of the ornithologists in this country.

50, KAILAS BOSE STREET,
CALCUTTA,
July 29, 1931.

SATYA CHURN LAW.

[In an issue of the *Girl Guides' Magazine*, 1928, under Nature Notes, there is a record of a pair of Java Sparrows nesting near Poona.]

XV.—NOTE ON THE BREEDING OF THE INDIAN MOORHEN (*GALLINULA CHLOROPUS PARVIFRONS*).

Sir,

In his article on the Indian Moorhen (*Gallinula chloropus parvifrons*) in the *Journal*, vol. xxxi, p. 542, Mr. Stuart Baker writes, *à propos* of its nesting, 'Hume seemed to think that they had two broods in the year in the hills, laying first in May and again in the latter half of July but other observers think they have only one set of eggs in the season'. It may be of interest to know that Hume was right, though a little out as to the times of laying.

There is in my garden a large tank, nearly 100 yards square, in the middle of which is a small island, covered and surrounded by a bed of reeds, on which are three or four trees growing. In the tank are several broad belts of white lotus, and there is a certain quantity of water weed of various kinds. The surroundings are quiet and the tank is a sanctuary, which is visited by a number of water birds. Major-General Sir James Johnstone, who was Political Agent fifty years ago, has recorded that geese were to be seen there in his time, and I have seen nine varieties of duck on the tank. Frequently one or two pairs of Whistling Teal (*Dendrocygna javanica*) breed on the island.

For some years past a pair of moorhens have yearly brought up a family on the tank. Though I have sometimes noticed a late brood, I have never actually seen two in a season, and always thought that a late family denoted the failure of a first brood. But this year I noticed the pair with two young ones (I subsequently saw a third), nearly as large as mynas on May 7. These young birds, now practically as large as the parents, are still on the tank. The day before yesterday I found the hen feeding on the lotus leaves near the bank of the tank. She was very agitated when she saw me, and ran over the leaves in the direction of the island, making the call which I have learnt to associate with the collection of her young. I watched, and saw three minute chicks, in black down, running over the leaves after her. Eventually they took to the water and all reached the shelter of the reeds.

Apart from young birds, I have never seen more than one pair of moorhens on the tank: I know of no water within half a mile of this tank where moorhens are to be found. I think there can be no doubt that the same pair of moorhens have brought off two broods, hatched (not laid) in late April and late July.

THE RESIDENCY, IMPHAL,
MANIPUR STATE,
July 28, 1931.

J. C. HIGGINS, I.C.S.

[Subsequent to the receipt of the above note Mr. Higgins, in a letter to the Society, says: 'In continuation of my letter of July 28, on the subject of the Indian Moorhen (*Gallinula chloropus*), I may say that the second brood consisted of six, not three. I have seen the chicks several times, escorted sometimes by a parent, sometimes by one of the first brood, running about on the lotus leaves.

'On the 10th instant I saw one of the Whistling Teal (*Dendrocygna javanica*) on the tank escorting three very small ducklings about the lotus leaves.'—Eds.]

XVI.—DESCRIPTION OF THE IMMATURE PLUMAGE OF THE INDIAN PRATINCOLE OR SWALLOW PLOVER (*GLAREOLA M. MALDIVARUM*).

We are greatly indebted to Mr. C. F. Jeffery, State Engineer, Manipur, Assam, for the above mentioned specimen, a description of which has not been recorded in the new *Fauna of British India*, Birds.

Forehead, crown and nape dark brown, the feathers faintly edged with buff; a well-defined supercilium creamy buff streaked with brown; whole upper plumage except rump brown, the feathers edged with buff forming crescents on the scapulars, wing coverts and lower back. Rump pure white; tail feathers blackish brown with broad white bases; tipped buff. First three primaries blackish brown; the remainder edged creamy white. Auxillaries and under-wing coverts rusty red. Chin and throat white, the sides of the neck streaked

with brown forming an irregular gorget on the upper breast. Lower plumage white flanked grey.

Bill and feet black.

BOMBAY NAT. HIST. SOCIETY,
APOLLO STREET, BOMBAY,

V. S. LAPPERSONNE, M.B.O.U.

September 30, 1930.

XVII.—EARLY ARRIVAL OF FANTAIL SNIPE
(*GALLINAGO GALLINAGO*) IN MANIPUR.

It may be of interest to record that I shot a Fantail Snipe (*Gallinago gallinago*) this morning. The earliest date on which one is known to have been shot previously in Manipur is August 24. Including this one, only 11 have been shot in August in the past 20 years.

Our earliest record for the Pintail Snipe (*Gallinago stenura*) is August 2, 1930, when one was shot by Capt. G. F. Bulfield of the 216th Gurkha Rifles.

THE RESIDENCY, IMPHAL,
MANIPUR STATE,

J. C. HIGGINS, I.C.S.

August 16, 1931.

XVIII.—THE DISTRIBUTION OF THE EASTERN GREY
DUCK (*ANAS PÆCILORYNCHA ZONORYNCHA*).

I note Mr. Higgins' remarks, in vol. xxv, No. 2 of the *Journal*, on a letter of mine about the first Indian record of the Eastern Grey Duck (*Anas pæcilorhyncha zonorhyncha*).

If he will turn to Mr. Stuart Baker's *Game Birds of India, Burma and Ceylon*, vol. i, '*Ducks and their Allies*', he will find that the birds got by Messrs. Moore and Mundy and others in Assam and Burma (with the exception of the two *zonorhyncha* mentioned by me) etc., were the Burmese Grey Duck (*Anas pæcilorhyncha haringtoni*) a quite different bird with a blue and not a green speculum. In the *Fauna of British India*, 2nd edition, vol. vi, under '*Anas zonorhyncha*' is the following note on distribution:—'There is one specimen from Kentung, Southern Shan States, in the British Museum collection, whilst Harington also shot one at Taungyi, Burma, in December 1911.' In vol. viii, p. 702, of the same work Stuart Baker writes: 'Inglis obtained a typical specimen of this duck in Behar, an extraordinary extension of its range.'

MUSEUM HOUSE, DARJEELING,
October 30, 1931.

CHAS. M. INGLIS,
F.Z.S., F.E.S., E.M.B.O.U.

XIX.—THE STIFF-TAILED DUCK (*ERISMATURA*
LEUCOCEPHALA).

I was very interested in Captain Whitehead's article on the Stiff-Tail in vol. xxxv.

I relate the following as rather an unusual occurrence. Early this June, during a furious dust storm, I noticed a solitary duck on the

reservoir that contains the Peshawar water-supply. As this is a strange resting-place for duck in June, I was determined to identify the intruder, so had it put up and shot it as it came round. It was a Stiff-Tail.

BARA FORT (N.-W.F.P.),
August 4, 1931.

M. G. DE L'ISLE STURM,
Captain, Royal Army Medical Corps.

XX.—FLYING FROGS.

I was interested in the note entitled 'A Flying Frog' at page 220 of the *Journal*, vol. xxxv.

I first saw a very similar frog shortly after my arrival in Rangoon at the end of 1930. It lived in our drawing room for many days, being usually seen on the wall or side of a piece of furniture. It appeared quite fearless of humans and jumped freely, giving the impression of never looking before it leapt, but always arriving safely at some unlooked for destination. At night it hid in a pigeon hole of the writing table.

We left that particular house about that time so I do not know what became of it.

Some weeks later when driving my car it showed symptoms of serious misfiring. On opening the bonnet I found a 'flying frog' gripping the steering column and very near the distributor. I removed him gently but firmly and the car ran perfectly, so I can only presume it was causing a 'short' somewhere.

A few days later, another, or possibly the same flying frog was found in the porch of our new and present bungalow. As the car always stands in the porch perhaps it was heading for the engine. It was personally conducted by my driver among the shrubs and plants of the front garden which it reached by a series of half-hearted bounds.

Two days ago another such frog was discovered in a bathroom, on the first floor, hiding behind a curtain. This was definitely a smaller specimen with black mottled markings on its back and flanks, and a distinctly more pointed snout than the illustration in your *Journal*.

I took it downstairs and it disappeared. I have not seen these frogs fly but should imagine they could glide some distance. I have never seen them feed, but fancy their diet must be similar to that of lizards, as they live the same kind of life.

RANGOON,
September 18, 1931.

J. G. P. DRUMMOND,
Major.

XXI.—CASE OF RECOVERY FROM THE BITE OF A PHOORSA (*ECHIS CARINATA*).

The patient passed over shellfish shingle in the compound to look out for a ship at 4-45 a.m. at Marmagoa on Saturday, May 30. Was bitten in the left foot as he returned to the house, but thought it must have been a scorpion as snakes are not expected on the shingle.

Sent a note at 6-30 a.m. asking for a doctor to be sent, meanwhile painted the punctures with Iodine.

A *mantra* man was seen at 7 a.m. who stated that it was a bite by the snake known as a Phoorsa, and commenced the usual treatment.

At 8 a.m. the doctor arrived and since the man was treating the foot he agreed to let him carry on although he had brought an injection of gold chloride. He left, and asked for a report in the evening. The foot was now swelling considerably and turning colour.

From the time of the bite up to 9 a.m. the patient fainted, and again several times nearly fainted. Was given brandy.

Another doctor came in the evening and as the leg was very much swollen and discolored and the blood pressure low, he called in another doctor. The *mantra* treatment continued with a last application at 6-30 p.m.

The patient passed a bad night on Saturday and in the morning on examination by the doctor the urine was thick and blood coloured, the blood pressure worse and temperature sub-normal.

Sunday, June 1.—Passed a bad night. The leg was still swelling and extending, dark blue patches appearing on different parts of the body. The doctor applied leeches. The *mantra* treatment was continued. There was excessive bleeding from the wounds. The patient passed a bad night. Condition low.

Monday, June 2.—More dark-blue coloured patches appeared on the arms and body. The blood pressure was unsatisfactory, so another doctor was summoned. At noon the patient was very low, there was excessive bleeding from the wounds, also from the centres of the patches, which had the appearance of the top of a pepper castor. The surgeon from the Hospicio Hospital (Dr. Dias) at Margoa was then called. Margoa is about 20 miles from Marmagoa. He arrived at 3 p.m. and immediately cauterised the whole of the flesh from the toe and well around the place of the bite with a blow lamp and instrument. He injected a full dose of polyvalent anti-venine as no other was available and removed the patient to the hospital 20 miles away, by car. On arrival the whole of the leg was placed in cotton wool and douches of Mag. Sulph. lotion applied day and night for about 10 days (anti-gangrene treatment) and a local lotion applied to the wound. Nothing but black coffee was given to the patient. After four days the patient was allowed a little milk. The leg re-acted to the treatment, the patches on the body and the whole of the leg faded somewhat. Another injection of anti-venine was given on Tuesday and one on Wednesday, June 3, after which the whole of the discolorations faded, those on the body fairly rapidly. Except for a few hours after each of the injections, the temperature of the patient was constantly sub-normal.

The leg slowly became reduced in size, the discolorations became less pronounced, the wounds steadily healed up and new flesh grew, covering up the exposed bone. The patient left for Bangalore on June 21 and reported to Colonel McPherson, Surgeon Superintendent of the Bowring Hospital. On arrival there, temperature was 97° and condition low. Internal medicine was prescribed and the leg had to be kept at rest. The patient has since recovered in general health.

but the final healing of the wound is slow, and the foot still discolours on being subjected to pressure.

The gold chloride was not injected.

BOMBAY,
September, 1931.

W. T. E. HUFFAM.

XXII.—TREATMENT OF SNAKE BITE

We have been interested in the treatment of the bites of the American poisonous snakes and during the last four years, the death-rate has decreased by about 100 a year. We attribute this success to—

(1) Reduction of the amount of venom absorbed by Mechanical Suction, 20 minutes an hour, 15 hours.

(2) Neutralizing the venom in the circulation with anti-venine (a polyvalent serum) in repeated doses until neurotoxic symptoms disappear.

(3) Treat shock.

(4) Replace the blood destroyed by the venom by blood transfusion, saline or glucose solutions intravenously and by protoblysis.

We have had remarkable success in serious cases by persistent treatment. We have had cases live after the pulse stopped for many hours—in the case of a soldier for 24 hours and a woman for 19 hours. We have had great success with Mechanical Suction in rattlesnake bites and use a rubber bulb made by Fleck Headrick Co., 521 North Alamo, San Antonio, Texas, in the field or an aspirator in the hospital. See 'Mechanical Treatment of Rattle Snake Venom Poisoning' by Dudley Jackson, M.D. and W. T. Harrison, Surgeon, U. S. Public Health Service, in the *Journal of the American Medical Association*, June 16, 1928 and *Treatment of Snake Bite* by Dudley Jackson, *Southern Medical Journal*, July 1929, and *First Aid Treatment for Snake Bite* in the *Texas State Journal of Medicine*, July 1927. I also have articles in the same numbers.

THE STABLES,
NAROTON, CONN., U.S.A.,
July 15, 1931.

M. L. CRIMMINS,
Col., U.S. Army, Ret.

XXIII. SNAKES ON THE BARS LIGHT RAILWAY (DECCAN).

The Bars Light Railway extends from Miraj in the south-western corner of the Bombay Deccan to Latur in the northern part of Hyderabad, covering an area 203 miles long on the Deccan plateau between the river Kistna in the south-west and the Godavari's tributary, the Manjra in the north-east. It is throughout a fairly uniform country with an average altitude of 1,600 to 2,200 ft. With the exception of a tract north-east of Miraj, between the stations Athni Road and

Jai Road, where bare rocky ridges and truncated hills rise above the plains and a narrow strip of mountainous country between Pangri and Yedsi made up of forest-clad hills and deep ravines, the plateau is only feebly undulated. The trap rock is mostly covered by black cotton and murmad soils with here and there patches of red soil. Trees are, as a rule, scarce though the *babul* is common enough and so are *nim* trees along the roads. Stoney barren stretches and cultivated fields of *juar*, cotton and groundnuts edged by the ever-present *Opuntia* and occasional agaves and here and there a sandy nala are the main features of the tracts covered by the railway—At the sacred city of Pandharpur, where thousands of Mahrattas congregate during the fairs to worship Vithoba, the Bhima is crossed, and 40 miles further north-east near Mahisgaon, its tributary the Sina. At Kurduvadi—the headquarters of the railway, the Barsi Light and Great Indian Peninsula Railways intersect while further north-east Barsi town with its important grain market and spinning mills and Latur with its ginning and pressing factories are given an outlet for their products through the Barsi Light Railway.

In order to acquire a knowledge of the kinds of snakes present along the railway and the relative proportion of poisonous species, a bounty of 2 annas was paid for each specimen during a period of about two years.

From August 19, 1929, to November 1, 1931, a total of 458 snakes belonging to 19 different species were received at the Kurduvadi dispensary.

These are tabulated below giving a percentage of 15·7 of poisonous specimens (72 out of 458):—

Dipsadomorphus trigonatus	...	...	103
Lycodon aulicus	...	...	95
Macropisthodon plumbicolor	...	...	40
Coluber helena	...	...	40
Naia tripudians	...	...	37
Zamenis fasciolatus	...	...	28
Eryx conicus	...	...	24
Echis carinata	...	...	23
Typhlops braminus	...	...	13
Coronella brachyura	...	...	10
Nerodia piscator	...	...	10
Ptyas mucosus	...	...	9
Bungarus cæruleus	...	...	8
Oligodon arnensis	...	...	5
Typhlops acutus	...	...	4
Eryx jaculus	...	...	3
Callophis trimaculatus	...	...	3
Oligodon taeniolatus	...	...	2
Vipera russelli	...	...	1

Whereas a sufficiently representative number was received from Kurduvadi, only scanty specimens were forthcoming from other stations and from many of these none at all was obtained. It is however likely that all the above species, with possibly one or two

exceptions, occur throughout the entire tract of land covered by the Railway.

The distribution according to localities is given below, the stations being ranged from LATUR, the north-eastern terminus in the Nizam's Dominions to MIRAJ in the Southern Maratha country :

Latur—

Macropisthodon plumbicolor	...	1
Naia tripudians	...	1

Hangul—

Dipsadomorphus trigonatus	...	4
Macropisthodon plumbicolor	...	1
Naia tripudians	...	1
Oligodon arnensis	...	1
Oligodon tæniolatus	...	1

Owsa Road—

Dipsadomorphus trigonatus	...	2
Macropisthodon plumbicolor	...	2
Lycodon aulicus	...	1
Ptyas mucosus	...	1

Murud—

Dipsadomorphus trigonatus	...	4
Naia tripudians	...	2
Coluber helena	...	1
Bungarus cæruleus	...	1

Kalamb Road (Tadvala)—

Coluber helena	...	3
Lycodon aulicus	...	1

Pangri—

Naia tripudians	...	1
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Barsi Town—

Macropisthodon plumbicolor	...	1
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Shendri—

Naia tripudians	...	2
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Chink Hill—(and neighbouring village).

Dipsadomorphus trigonatus	...	13
Lycodon aulicus	...	9
Coluber helena	...	6
Echis carinata	...	5
Macropisthodon plumbicolor	...	2
Zamenis fasciolatus	...	2
Coronella brachyura	...	2
Naia tripudians	...	1
Ptyas mucosus	...	1
Typhlops braminus	...	1
Nerodia piscator	...	1
Vipera russelli	...	1

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Kurduvadi—

Lycodon aulicus	77
Dipsadomorphus trigonatus	64
Naia tripudians	27
Coluber helena	...	...	26
Macropisthodon plumbicolor	...	...	25
Eryx conicus	...	...	24
Zamenis fasciolatus	...	...	23
Echis carinata	...	...	13
Typhlops braminus	...	...	11
Coronella brachyura	...	...	8
Nerodia piscator	...	...	6
Ptyas mucosus	...	...	4
Typhlops acutus	...	...	4
Bungarus cæruleus	...	...	2
Oligodon arnensis	...	...	2
Eryx jaculus	...	...	2
Callophis trimaculatus	2
Oligodon tæniolatus	1

Padsali—

Ptyas mucosus	1
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Modlimb—

Bungarus cæruleus	1
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Ashti—

Dipsadomorphus trigonatus	4
Lycodon aulicus	2
Echis carinata	2
Typhlops braminus	1
Naia tripudians	...	...	1
Bungarus cæruleus	...	...	1

Pandharpur—

Lycodon aulicus	...	...	3
Dipsadomorphus trigonatus	...	...	2
Macropisthodon plumbicolor	...	...	2
Oligodon arnensis	...	...	2
Nerodia piscator	...	...	2
Coluber helena	...	...	1
Naia tripudians	...	...	1
Ptyas mucosus	...	...	1
Bungarus cæruleus	...	...	1
Eryx jaculus	...	...	1
Callophis trimaculatus	...	...	1

Bohali—

Dipsadomorphus trigonatus	...	...	6
Macropisthodon plumbicolor	...	...	4
Coluber helena	...	...	2
Echis carinata	...	...	2
Zamenis fasciolatus	...	...	1
Bungarus cæruleus	...	...	1

Bamani—

<i>Dipsadomorphus trigonatus</i>	...	...	2
<i>Lycodon aulicus</i>	...	...	1

Wasud—

<i>Dipsadomorphus trigonatus</i>	...	...	1
<i>Lycodon aulicus</i>	...	...	1
<i>Macropisthodon plumbicolor</i>	1
<i>Coluber helena</i>	1
<i>Zamenis fasciolatus</i>	1

Jath Road—

<i>Bungarus caeruleus</i>	1
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Athni Road—

<i>Nerodia piscator</i>	1
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Miraj—

<i>Dipsadomorphus trigonatus</i>	1
<i>Ptyas mucosus</i>	1

The seasonal distribution of the commonest species during the two years' period, August 19, 1929, to August 18, 1931, was found to be the following. The month in which the largest number of each was observed being given in the table:

<i>Dipsadomorphus trigonatus</i>	...	September	29
<i>Lycodon aulicus</i>	...	October	16
<i>Macropisthodon plumbicolor</i>	...	October	14
<i>Coluber helena</i>	...	September	9
<i>Zamenis fasciolatus</i>	...	November	8
<i>Naia tripudians</i>	...	November	7
<i>Typhlops braminus</i>	...	June	6
<i>Echis carinata</i>	...	October	5
<i>Eryx conicus</i>	...	May and January	4 each
<i>Coronella brachyura</i>	...	November	4

During the above-mentioned two years' period, the monthly distribution was the following:—

October—78; September—70; November—59; June—50; July—35; August—25; March—25; May—22; January—22; December—21; February—18; April—9.

Typhlops braminus, the Common Blind Snake appeared on the surface after heavy rains. The largest measured 18 cm. body, its tail was mutilated. The smallest 6.3 cm. body, 0.2 cm. tail; this was captured in the middle of September. Small beetles were found in the stomach.

Typhlops acutus, one was rescued by day from the beak of a cock; another was captured after dusk while crossing a road. The largest measured 35.2 cm. body, 0.4 cm. tail; the smallest 23 cm. body, 0.2 cm. tail.

Eryx jaculus, the Black Earth-Boa, a decidedly uncommon snake along the Railway. The largest measured 89 cm. body, 10 cm. tail; the smallest 35 cm. body, 4.8 cm. tail; this was found end of September.

Eryx conicus, the Red Earth-Boa, was captured by day in most instances. Sometimes in quarters, sheds and latrines. The largest

measured 72 cm. body, 4 cm. tail; the smallest 24.7 cm. body, 1.8 cm. tail; this was brought in the third week of July. Rats were found several times in the stomach. A specimen measuring 51.5 cm. body, 4 cm. tail was captured in the compound of the Roman Catholic Church at Kurduwadi in the act of crushing a full-grown striped squirrel. Gastric and intestinal nematodes and cysticerci were found in several instances.

Lycodon aulicus, the Common Wolf Snake, was chiefly found in quarters and after dusk. The largest measured 64 cm. body, 11.6 cm. tail; the smallest 25 cm. body, 4.3 cm. tail. Pregnant females were received in March, April and May. Lizards (*Hemidactylus leschenaulti*, *Calotes versicolor*, *Mabuia carinata*) and small rodents were the common findings in the stomach. Adult parasitic helminths were sometimes seen, but stomach walls and mesentery studded by cysticerci and nematodeora were almost constantly observed in full-grown specimens.

Coronella brachyura, this unobtrusive but handsome little snake was found by day; the first specimen observed climbing on the wall of the dispensary. The largest measured 49 cm. body, 2.3 cm. tail; the smallest found beginning of November; 21.4 cm. body, 3.1 cm. tail.

Oligodon arnensis, the Banded Kukri Snake, largest specimen 52 cm. body, 7.8 cm. tail; smallest 29.5 cm. body, 6 cm. tail.

Oligodon taniolatus, the Variegated Kukri Snake. Largest specimen 42.2 cm. body, 6.7 cm. tail; smallest 41 cm. body, 6 cm. tail.

Ptyas mucosus, the Common Rat-Snake, was found by day. The two largest specimens measured 165 cm. body, 51.5 cm. tail and 163 cm. body, 66 cm. tail. The smallest received in the beginning of November 57 cm. body, 21 cm. tail. An egg-bound female was found in May. A few specimens were infested by ticks and gastric nematodes. The dhaman does not seem to be a very common snake along the Railway, nor does it attain the large size often observed by the author in the United Provinces.

Zamenis fasciolatus, the Fasciolated Rat-Snake, was constantly found by day and often in open places. In one instance a large specimen was captured in a poultry-yard. The largest and smallest individuals measured 97 cm. body, 24 cm. tail and 29.3 cm. body, 3.5 cm. tail respectively. The latter was brought end of August. Rats were commonly found in the stomach. Gastric nematodes and intestinal cestodes were observed in a few cases.

Coluber helena, the Trinket Snake, was chiefly encountered by day and near dwelling-places. The largest and smallest specimens seen measured 114 cm. body, 25 cm. tail and 30.5 cm. body, 6.2 cm. tail respectively. The latter found end of November. Egg-bound females were brought in July; one contained eleven full sized eggs. Rats, mice and other small rodents were found in the stomach. Helminthic infestation was not observed in any case.

Macropisthodon plumbicolor, the Green Keelback, was captured both by day and by night in grass and while crossing roads. The largest measured 79.5 cm. body, 9.5 cm. tail; the smallest 15.5 cm. body, 2.8 cm. tail (found in the third week of October). Pregnant females were seen in March, April and May. Frogs and toads (*Bufo*

melanostictus) were found in the stomach. Acanthocephala were observed in a few specimens, but the majority were free from helminthic infestations.

Dipsadomorphus trigonatus, the Common Indian Catsnake, was found both by day and by night, commonly in gardens and around quarters. The largest specimen measured 91 cm. body, 16.5 cm. tail; the smallest 41.5 cm. body, 10 cm. tail. Pregnant females were encountered in May, June and July; one of them containing 14 full sized eggs. In the stomach the commonest contents were small birds, chickens and eggs. Infestations with gastric nematodes and intestinal cestodes were often seen.

Callophis trimaculatus, the Slender Coral Snake. This graceful animal was found by day in the three instances and when captured was seen playing its trick of raising the tail and hiding its head. It never attempted to bite. The largest specimen measured 3.33 cm. body, 2.6 cm. tail; the smallest 20.2 cm. body, 1.9 cm. tail.

Bungarus caruleus, the Common Krait appeared to be fairly uncommon, only eight specimens being received. The largest measured 87.5 cm. body, 12.4 cm. tail. The smallest 54.5 cm. body, 9.4 cm. tail.

Naia tripudians, the largest Cobra, a male, measured 149 cm. body, 28.3 cm. tail; the smallest, killed end of August, 27.5 cm. body, 5.3 cm. tail. In the stomach were found toads and small birds and in one case another snake—a cobra measuring 44.8 cm. body, 8.8 cm. tail, having swallowed a *Lycodon aulicus* measuring 45.5 cm. body, 9 cm. tail. A few specimens had gastric nematodes and acanthocephali. Old individuals were generally infested with ticks.

Vipera russelli, the Russell's Viper, is the rarest snake in our series, as only one specimen was brought. This was killed by a farmer in a cow-shed near a village about 2 miles from Chink Hill station. It measured 133 cm. body, 24 cm. tail.

Echis carinata, the Saw-scaled Viper, was found by day and in most cases brought alive to the dispensary. The largest measured 40 cm. body, 3.8 cm. tail; the smallest, received beginning of November, 19 cm. body, 1.6 cm. tail. On opening the stomach centipedes were found several times and once a lizard, a *Hemidactylus*. Some individuals were infested by a few nematodes and cestodes.

During the period under review three cases of snake-bite inflicted by poisonous snakes were brought to our notice, and only one of them came to treatment.

At Pangri, a gangman was bitten on his right heel on June 6 at 8 p.m. by a snake described as being darkish and about 1½ foot long. The wound kept on bleeding continuously until 12 noon the following day when it was incised and potassium permanganate rubbed into it. The whole right lower limb was then found marked by swollen purpuric patches, and blisters containing hæmorrhagic serum developed later on the right foot. There were several vomitings and diarrhoeic stools, but as these occurred after taking of a native remedy by the gangman soon after the bite, it is not possible to say whether they were due to the remedy or to the snake venom. The patient recovered but it took over two months for the œdema to disappear entirely. It is likely that this was a case of bite inflicted by the Saw-scaled Viper (*Echis carinata*).

At 3 o'clock in the morning of August 8, a sweeper woman at Barsi town sleeping on the floor suddenly woke up saying to her husband that she had been bitten by a rat. After five minutes she had the sensation of needles and pins over her whole body and she experienced a great thirst. Her speech soon became stammering and after 4 a.m. she could not utter a word. Frothy saliva came out from her mouth. She was dead at 6 a.m. There were two punctured wounds below her right knee. No snake was seen. This is likely to have been a case of cobra bite.

An oil engine driver at Jath Road station was bitten at about 10 p.m. on July 23 on the middle of his back while sleeping on the floor of his quarters. He went for treatment to the temple of the village $\frac{1}{2}$ mile distant and was given a decoction of *nim* leaves which he vomited. He then felt better and returned to his quarters at 11 p.m. Shortly afterwards he said that his 'lungs were getting dry' and he had difficulty to speak. He was then again taken to the temple where he was seen by the Station Master at about 10 a.m. the following morning. He could then neither speak nor move his limbs according to the report of the Station Master. He expired at about 2 p.m. the same day. The snake in this case was killed and sent to Kurduvadi for identification. It was a *Bungarus caeruleus* measuring 74.5 cm. body and 12.2 cm. tail.

KURDUVADI,
BARSİ LIGHT RY.,
November 1931.

K. LINDBERG.

XXIV. DESCRIPTION OF A NEW *LYCÆNID* BUTTERFLY.

Lycaena (Formerly *Heodes*) *irmae* Sp. nov.

7 Specimens. Gyantse Tibet 13,000 feet. June.

♂ *Above*. Purple-brown.

F.W. A spot in the cell.

An elongated spot marking the disco-cellulars. Beyond this on the disc, three dark spots in a straight line. Below this line and set at an angle to it, two faint spots in interspaces 2 and 3.

A terminal dark band having a yellow centre at the tornal end.

This yellow streak gets fainter towards the apex and disappears in interspace 3.

H. W. A dark line in the cell.

At the tornal angle, a very thin terminal line followed by a black spot in each interspace, followed internally by a dark line of lunules inside of which the purple gloss on the wing is slightly brighter almost forming a purple sub-terminal line. All these markings become fainter towards the apex.

Below.

F.W. Dull yellow.

The marks in the cell and on the disc more pronounced. Those in the cell surrounded with white. The discal marks inwardly margined with white.

A smoky black sub-marginal line with a few whitish scales down the centre at its apical end. Next, a broad band of the ground

colour of the wing, getting fainter towards the apex. A sub-terminal line of elongated spots one in each interspace those in 2 and 3 the most pronounced.

H.W. Yellowish grey with the following black markings inwardly bordered with white. A line of 3 in a straight line at the base of the wing, the centre one being in the cell. Another in the cell with one below it in interspace 2. The disco-cellulars marked as above but much more distinctly, continued at both ends as an irregular line pointing towards the tornus. Below this a bowed line pointing towards the tornus. An irregular line of four dots on the disc. A discal line of white lunules bordered with dusky. A broad terminal yellowish band outwardly margined pale with a terminal dark line. In this band are dark spots getting fainter towards the apex, those in interspaces 1 and 3 are the most pronounced.

♀ As the male but the forewing has a distinct coppery tinge and the purple on both wings is more pronounced.

The spots on the disc are also more defined than on the male and form a curved line inwardly margined with purple. Outside is a yellow line from the costa half way across the wing.

On the hind-wing there are a few faint dark markings inwardly bordered with purple. The tornal markings are more distinct than in the male and there is a line of purple lunules inside of the marginal markings. Underside as in the male but forewing and the tornal markings on the hindwing are more yellow. Cilia of all wings fringed with white. Antennae ringed black and white; expanse 29 mm. to 34 mm. Types of ♂ and ♀ in the British Museum.

The nearest ally to this distinct species is *Heodes li* from which it differs markedly in having no tail.

I have taken *Heodes li* on the Chinese Tibetan border at an altitude of 11,000 feet about 600 miles east of the locality where the present species was found.

Flies among low bushes on the open hillsides in the dry country round by Gyantse, Tibet.

SATNA, C. INDIA,
October 1931.

F. M. BAILEY,
Lt.-Col.

XXV.—DISTINCTIVE CHARACTERS OF THE BUTTERFLIES (*APPIAS LIBYTHERA LIBYTHERA* F. ♂) AND (*APPIAS ALBINA DARADA*, Fd. ♂.)

(With a diagram.)

I venture to put forward this note on these two butterflies in the hope that it may be of use to others who, like myself, may find it as difficult as I did, to be sure of distinguishing between them.

Hannington, in his list of Coorg butterflies, says that *A. libythea* intermingles with the other *Appias* on the western slopes. This statement led me to search diligently among the swarms of *A. albina* ♂♂ which haunt the streams and woods. I had Evans' descriptions of the two and consulted Bingham over and over again;

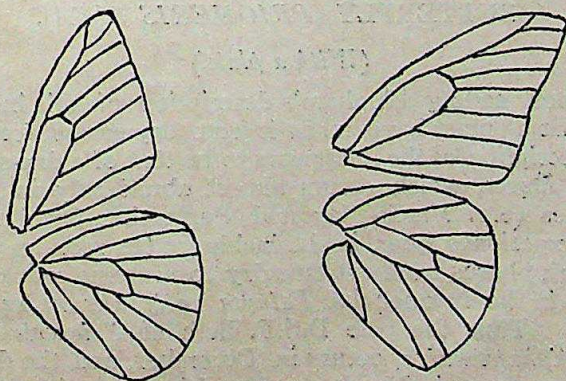
often I thought I had *A. libythea* ♂, and indeed frequently so labelled my slips, but I was always rather doubtful, because at no time did I see the very distinct ♀. On the other hand, in the Bangalore jungles where *A. libythea* undoubtedly occurs alongside *A. albina*, I took ♂♂ of the former which I wrongly labelled *A. albina*, again doubting, because I took them on the same shrubs as I took *A. libythea* ♀♀.

Having now set and examined my catches and having seen the collection of Col. Winckworth and that in the Natural History Museum at South Kensington, I see where my trouble arose, and have noted a few definite characteristics of each, so that I feel sure I should not again be in the quandary I was.

The only illustration I had of *A. libythea* ♂ was that given in Antram's *Butterflies of India*: it is evidently not the S. Indian race that he represents. I turned to Bingham who says '♂ upperside pure white, forewing, costa, apex and termen anteriorly very narrowly shaded with dusky black scales, the black colour produced very freely along the veins for a short distance' (W.S.F.). Again, D.S.F. ♂ 'Similar but narrow black markings on the forewing still more restricted.' Evans has—'♂ upf veins only dark at margin and not inwardly edged by a dark band'.

I turned up '*A. albina*', Evans has 'Apex F pointed and termen straight. ♂ upf blackish scaling at apex and base very narrow or absent.' Bingham says much the same with a little more detail. The black scaling is continuous along the termen and not confined to the ends of the veins and inwardly along them.

I suppose a beginner does not go into the more minute differences, such as the colouring of the head, thorax, abdomen; and antennae; and in any case the differences are very slight, and variation seems to be considerable. For myself I was troubled by *A. libythea* ♂♂, taken in the dry season, on which the black scaling was indistinguishable from that of many intermediate types of *A. albina* ♂. (These are represented in the collection at the Natural History Museum, South Kensington). On the other hand a good many *A. albina* ♂♂ (of the W. S. type) seemed very similar to the undoubted W.S.F. of *A. libythea* ♂.



a. *Appias libythea* ♂

b. *Appias albina* ♂

Mr. R. Winckworth very kindly pointed out to me the first two of the following four obvious differences, which are constant, and have made it possible to distinguish with certainty the one ♂ from the other.

1. *A. albina* ♂: Upf: at the base the white scales have a definitely and obviously pearly tint, which extends more or less over half the wing. In *A. libythea* ♂ the white is uniformly matt.

2. As will be seen by a comparison of the diagrams of the wings of the two butterflies (on page 699), there is considerable difference in the venation, most obviously in the cell of *hw*. Note particularly the difference in the way that *vv* 3, 4, 5 and 6 radiate from the cell in each, and the difference in shape of the two cells.

3. The apex of *fw* of *A. albina* is more pointed and produced than that of *A. libythea*. Consequently the angle made by the termen with the costa is in the former more acute than in the latter. (In most ♂♂ of *A. albina*, the termen, owing to a slight indentation at *v*. 4, from *v* 5 to *v* 6, has the appearance of being slightly falcate. This does not happen in *A. libythea* ♂♂).

Again the tornus of *A. albina* ♂, both of *fw* and *hw*, but more pronouncedly of *hw*, is sharper, more angular, than that of *A. libythea* ♂, which is clearly more rounded.

4. Antennae. (The difference here noted is best seen through a magnifying glass.)

A. libythea. About one-third of the club above is rather brightly ochraceous. The underside of the club is ochraceous. The annulation or speckling, brown and pale ochraceous, is much less distinct than in *A. albina*. The general effect is brown, lighter than in the latter.

A. albina. Only the tip of the club is light ochraceous; the rest is black above, as also beneath, except for three or four white spots. The annulation of the stem is distinct, black and white, and the general effect is much darker than in *A. libythea*.

BERKHAMSTED,

April 18, 1931.

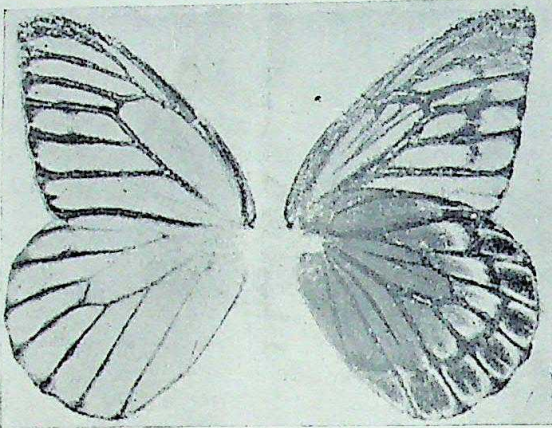
J. A. YATES.

XXVI.—DRY AND WET SEASON FORMS OF THE BUTTERFLY (*PRIONERIS SITA*).

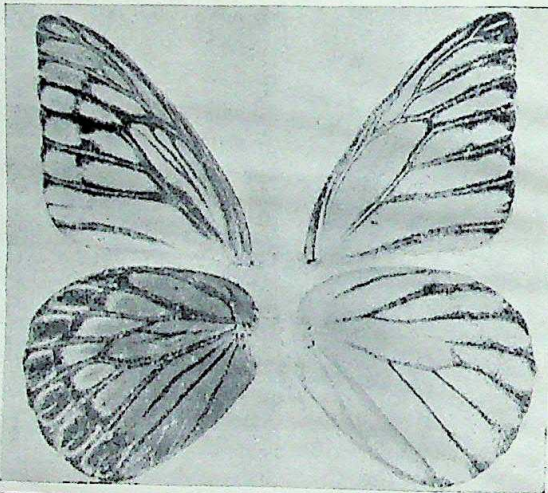
(With a plate.)

I have been reading Bingham's description of this butterfly, and conclude that he must have made it from dry season forms; at any rate his description of the ♂ appears to be that of a dry-season ♂.

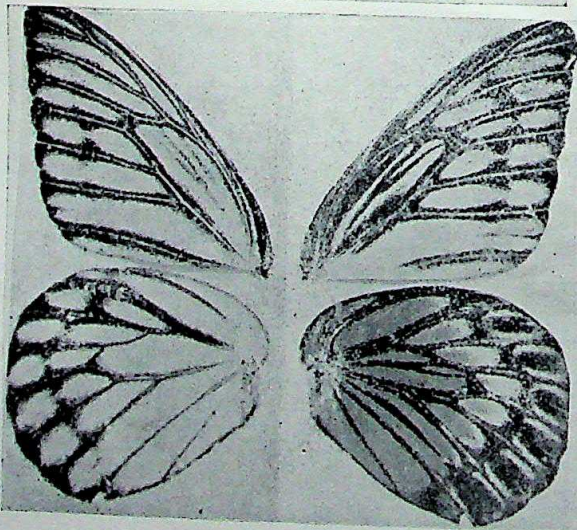
But this insect, which occurs almost abundantly in S. Coorg at certain times (e.g. March-May and September-October) and, so far as my experience goes, is obtainable for ten months of the year, goes through phases from extreme dry to extreme wet colouration; very much in the manner that *Pathysa antiphates naira* does at the same time. Thus the pale D.S.F. both of *Prioneris sita* and of *Pathysa antiphates naira*, occurs in December, and the dark W.S.F. in both cases comes in March-April, and between the two there are transitional broods.



Dry Season Form.
♂ December 1928.



Intermediate Form.
♂ 31st Dec. 1928.



Wet Season Form.
♂ March 1928.

DRY AND WET SEASON FORMS OF *Prioneris sita*.

Bingham says '♂ *Upperside* . . . the postdiscal markings of the underside seen through faintly by transparency,' these markings include a 'postdiscal black band' on the hindwing. But in the W.S.F. there is on the upperside also an almost continuous similar black band, that divides the white of the interspaces 1 to 5; and the black bands along the veins are much wider, so that the white between them is further reduced; and along the outer third of the veins the black thickens into triangular markings, and the white between the postdiscal band and the margin becomes a series of roughly heart-shaped blobs. On the forewing also the black bands along the veins are much wider in the W.S.F. than in the D.S.F., with a resulting diminution of the white areas in the interspaces. And on the underside the black borders of the veins are correspondingly thickened; as also are the 'longitudinal black lines' which traverse the cell on the f.w. (3) and on the h.w. (2). Bingham notes as a distinguishing mark of the ♀ that the cell of the forewing (upperside) is 'traversed by three slender longitudinal lines'—which are strongly marked below in both ♂ and ♀. In the very dark W.S.F. ♂♂, these lines occur above (not by transparency from below) but not so strongly scaled as in the ♀.

The difference between D.S.F. and W.S.F. will be clear if the two photographs on the accompanying plate are compared.

Apart from the fact that the black markings on the wings of the ♀ are generally broader than those on the wings of the ♂ ('on the upperside the veins of the hindwing as well as of the fore being black right up to the base' (Bingham), the apex of the f.w. of the ♀ is rounder and less produced and the termen is slightly falcate at v 4.

BERKHAMSTED,
July 7, 1931.

J. A. YATES.

XXVII.—HOW ABUNDANT ARE LAND LEECHES?

After spending within three weeks of an entire year in India in investigations on the life-histories and behaviour of the true land leeches (*Hamadipsinae*), I am forced to the conclusion that they are less abundant than is generally believed. This is certainly true for the times and places of my studies. In preparing the account of these animals for the *Fauna of British India*, I read all available published statements, corresponded with many naturalists and others, and talked with returned visitors from India. From these various sources I had constructed a picture in which land leeches were figured as inhabiting infested areas in something like the order of one to the square inch. Such a picture seems justified by expressions like 'incredible profusion', 'on every grass blade and leaf' and many similar used by the describers. On arriving in India I found that my idea of the abundance of leeches was about the same, so far as favoured areas were concerned, as that held by experienced residents.

At first I was too busily occupied with other observations on these interesting animals to pay much attention to their mere

numbers but as figures accumulated, it became apparent: first, that their abundance nowhere approached what had been anticipated, and second, that my first impression of numbers on any spot invariably exceeded the actual number counted. I then began to search for densely populated spots and visited all so reputed, within reach, of which I could learn, only to suffer repeated disappointment. Nowhere were they as abundant as I had been led to expect.

Incidentally to the investigation there accumulated some hundreds of counts of the number of leeches actually taken or seen on a measured square foot or yard or multiple thereof, precautions being taken to standardize these counts and make them as accurate as possible. The most thorough work was done on the four species inhabiting the eastern Himalayas and extended throughout the Darjeeling District and southern Sikkim from early September to the middle of November 1930 and early April to the 1st of August 1931. Some of these figures for the common grass leech (*H. z. montivindicis*) are as follows: On small plots of ground selected for their density of population, the two most populous square feet yielded 20 and 18, followed by others on which were 14, 13, 12 and 9. The total number of land leeches counted on 67 square feet selected for maximum numbers was 376, an average of 5.5 per foot. On another grazing ground where leeches were considered to be troublesome 120 square feet, about equally divided between those selected for numbers and those taken at random, yielded 213 or an average of 1.8 per square foot. Many other similar counts were made and it must be remembered that these were on what are considered to be heavily infested areas, to which such descriptive terms as those quoted above have been applied. Similar results were had on a smaller scale with other species.

Evidently the superlative language used in describing the abundance of these leeches does not apply to my experience. I am puzzled to know just where the discrepancy lies. Have I read into the language of others a meaning not intended by the authors? Or are the impressionistic estimates of the abundance of these animals grossly exaggerated by reason of their unusual and conspicuous appearance, great activity and avidity, and the repugnance commonly felt towards them? Or was I so unfortunate as to have made my studies during a season of minimum abundance? I am very desirous of learning from those who have had much wider experience whether any marked annual fluctuation in numbers has been observed, with what conditions the wax and wane are correlated and whether the season of 1930 would be placed on a maximum or minimum scale. Can any readers furnish figures based on actual counts or really careful estimates of their numbers? How do my figures agree with the experience of others?

University of Pennsylvania, U. S. A.

J. PERCY MOORE.

FORM OF BEQUEST

I bequeath out of such part of my personal Estate as may by Law be bequeathed for such purposes to the Committee of the Bombay Natural History Society (registered under Act XXI of 1860) the sum of

free from Legacy Duty, for the benefit of the said Bombay Natural History Society, to be expended in such a way as the said Committee may deem expedient; and I direct that the receipt of the Treasurer for the time being of the said Bombay Natural History Society shall be an effectual discharge for the same legacy.

It is requested that those who in drawing up their wills make bequests to the Society should consider the possibility of instructing their Solicitors forthwith to communicate the facts to the Honorary Secretary.

13

11

JOURN. BOMBEY NAT. HIST. SOC.



THE CURLEW $\frac{1}{4}$
Numenius arquata arquata.

THE BAR-TAILED GODWIT $\frac{1}{4}$
Limosa lapponica lapponica.

JOURNAL OF THE Bombay Natural History Society.

JULY, 1932.

VOL. XXXV.

No. 4.

THE GAME BIRDS OF THE INDIAN EMPIRE.

BY

E. C. STUART BAKER, C.I.E., F.Z.S., F.L.S., M.B.O.U., H.F.A.O.U.

VOL. V.

THE WADERS AND OTHER SEMI-SPORTING BIRDS.

PART XVII.

(With a coloured plate.)

(Continued from page 483 of this volume.)

FAMILY: SCOLOPACIDÆ.

In this family, Lowe includes all those genera which, in the first edition of the *Avifauna*, were embraced in the two sub-families *Totaniinæ* and *Scolopacinæ*, with the exception of the one genus *Rostratula*, which I have removed from the latter sub-family and elevated to a sub-order by itself.

In this family the diagnostic characters are the scutellated tarsus and nasal groove which extends over more than half the length of the upper mandible.

The family is divided further into four sub-families, *Tringinae*, *Erolinae*, *Phalaropinae* and *Scolopacinae*.

The last of these four families embraces the Snipes and Woodcock, birds which have already been included in vol. ii of *Game Birds*. In the other three sub-families we find those numerous Waders, small and big, of which such vast numbers visit India and Burma during the Winter. Many of these might well be included among our Game Birds, for they are hard to approach, difficult to shoot and good to eat; others may have no pretensions to be classed as Game Birds, yet are of sufficient interest to deserve a brief notice, sufficient to enable sportsmen to identify them if and when shot.

Key to Sub-families.

- A. Eyes and ear-orifices placed normally.
 - a. Toes with no fringe of lobed web :
 - (i) Toes partially webbed at the base ... *Tringinae*.
 - (ii) Toes divided to the base ... *Erolinae*.
 - b. Toes with a fringe of lobed web. *Phalaropinae*.

- B. Eyes placed very far back in the head,
with the ear-orifice just below the
hinder edge of the orbit ... *Scolopacinae*.

SUB-FAMILY: TRINGINÆ.

The different genera in this sub-family agree in having a slender, and often rather lengthened bill, well provided with nerves. Except in *Numenius*, in which the back of the tarsus is reticulated, the tarsus is scutellated or transversely shielded both in front and behind. There is a distinct Summer and Winter plumage and the sexes are nearly always alike, except in the one genus *Philomachus*.

Key to Genera.

- A. Bill long and curving downwards ... *Numenius*.
B. Bill straight or curving slightly upwards.
a. Bill longer than tail :
(i) Bill not broader at the end ... *Limosa*.
(ii) Bill broader at the end and pitted ... *Limnodremus*.
b. Bill not longer than tail :
(i) Bill nearly twice as long as tarsus ... *Terekia*.
(ii) Bill shorter than tarsus or not much longer
(iii) Sexes alike :
a. Bill straight ... *Tringa*.
b. Bill curved upwards ... *Glottis*.
(iv) Sexes not alike in breeding season. *Philomachus*.

GENUS: NUMENIUS.

Numenius Brisson, ornith., i, p. 48, v, p. 311 (1760).

Type by taut *Numenius numenius* Brisson = *Scolopax arquata* Linn.

In this genus the bill is very long, slender and curved downwards over the greater part of its length; the tip of the upper mandible is blunt and projects beyond the lower mandible; the nasal orifice is linear and is placed in a groove which extends over about three-quarters the length of the bill; the legs are rather long; the tarsus reticulated except on the lower half in front, where it is covered with transverse scutellæ; the hind toe is moderate in size, the claws dilated and the toes webbed at the base; the wing is long and pointed, the first primary longest and the inner secondaries very long: sexes alike.

This genus contains the Whimbrels and Curlews, which are spread over the greater part of the world.

•Key to Species.

- A. Crown streaked; wing over 260 mm. ... *N. arquata*.
B. Crown brown with a pale median band;
wing under 260 mm. ... *N. phæopus*.

THE GAME BIRDS OF THE INDIAN EMPIRE

705

NUMENIUS ARQUATA.

Key to Subspecies.

- A. Lower parts broadly streaked; axillaries white with bold streaks of blackish. *N. a. arquata.*
 B. Lower parts finely streaked; axillaries pure white or finely streaked with blackish *N. a. orientalis.*

NUMENIUS ARQUATA ARQUATA.

The Curlew.

Scolopax arquatas.—Linn., Syst. Nat., 10th ed., i, p. 145 (1758) (Sweden).

Numenius arquata.—Blanford and Oates, iv. p. 252 (part). Fauna, B.I., Birds, Stuart Baker, vi, p. 200, 1919.

Vernacular Names.—Gour, Gough, Barra Gulinda (Hind.)

Description.—Upper plumage blackish-brown, the feathers of the head and neck with broad fulvous edges, paler and almost white on the sides of the head; mantle with the pale edges browner and assuming the shape of interrupted bars on the scapulars and inner secondaries: wing-coverts with whitish edges which also become similar bars on the greater coverts; a patch of feathers above and below the eye white; lower back and rump white, the centres of the feathers with broad streaks and sometimes bars of blackish; these vary greatly; in many the sides of the rump are pure white, the black showing only as a few black streaks, at the other extreme there are birds with the whole of these parts closely barred and streaked with blackish; upper tail-coverts and tail barred blackish and pale brown, the former more black and white; primaries black with white shafts and the inner webs barred with white, these bars extending on the inner primaries to the outer webs also; chin white; throat white with tiny black striæ, gradually enlarging towards the fore-neck; neck and breast fulvous with broad black central streaks; flanks white with central streaks and cross-bars of brown; abdomen, vent and under tail-coverts white with narrow dark brown centres, always less on the middle of the abdomen and vent and sometimes absent; under tail-coverts with broader dark centres; axillaries white with narrow black bars.

Colours of soft parts.—Iris brown; bill dark brown, the basal half fleshy-brown colour; legs and feet pale-grey, fleshy-grey or bluish-grey.

Measurements.—Wing, ♂ 280 to 303 mm, ♀ 295 to 321 mm.; tail 106 to 121 mm.; tarsus 66 to 80 mm.; culmen ♂ 100 to 124 mm., ♀ 130 to 152 mm. (*Witherby.*)

Young birds have the feathers of the upper parts edged with buff and the upper tail-coverts and rump suffused with buff, whilst the streaks on the breast and abdomen are narrower.

Nestling.—Above creamy-buff, the sides of neck and fore-neck darker rufous-buff and the under surface buffy-white; a broad central

streak of brown from forehead to nape; posterior crown freckled black and buff; an eye-streak dark brown; a dark brown patch on the hind-neck; two lateral bands of dark brown down the back; two patches of brown on the wings and two short blackish lines below the dorsal lines.

Distribution.—Northern and Central Europe, South to Dobrugea etc. In Winter, South to Africa, Madagascar and North-West India as far East as Delhi and as far South as Ceylon.

Nidification.—The Curlew breeds in Northern Europe from the end of April to the end of May and in its more northern limits as late as June, but I found eggs laid in the south of Lapland and in Northern Finland in the third week of May when there was still snow in drifts everywhere. They select a site anywhere in marshy land, whether this is almost on the level of the seashore or on the boggy crests of high hills. In England they are getting much more common than they were and in Eastern Wales and the adjoining counties they have even been known to breed in wheatfields and similar situations. Normally, however, their home is in the wilder countries and there is no bird whose nest is harder to find. The nest itself is a hollow in amongst grass or weeds either scratched out by the birds or a natural one, and this is almost invariably well lined with weeds, grass or soft reeds. Occasionally a nest may be found on dry sand hills some distance from any wet spot but as a rule this is only when the birds have been harried and driven from other more favourite wet grounds. When not sitting himself, sometimes the male bird keeps watch near the nest and gives the alarm to his mate on the approach of danger but, even when he does not do this, the sitting hen is so extraordinarily alert that it is very difficult to approach within two or three hundred yards of the nest before she leaves. When she does so she generally slinks quietly along for some distance before rising, so as not to give away the position of her eggs or young. If however one happens to come upon the sitting hen suddenly, she lies very close and I have occasionally been able to watch a bird from a distance of only a few yards for some time before she has eventually made up her mind to clear out. The eggs are of course always four in number and are very large for the size of the bird. In shape they are long pyriforms and the ground colour varies from a pale grey green to a rather dark olive-grey or olive-brown, occasionally almost bright olive-green. In most eggs the markings consist of small spots and blotches freely scattered over the whole surface of the egg but nowhere very bold or well-defined. A few eggs however have large handsome markings which are most numerous at the larger end and spare elsewhere, whilst a few others have the blotches intermixed with small twisted lines and scriggles. One hundred eggs average 67.2×47.4 mm.; maxima 75.5×55.0 mm.; minima 56.2×44.0 mm. and 61.0×43.0 mm.

Habits.—The Common Curlew is a numerous visitor to North-West India from whence it straggles down South as far as Ceylon and East as far as the United Provinces. There have also been a certain number on record from considerably further east, as from Bengal and Aesam, but I have seen no specimens thence and such

records are probably all referable to the next race of Curlew. Even in Sind and the Punjab many references to the Curlew must really be to the eastern form, for Ticehurst says 'Sind and Punjab birds are typical *lineatus* (= *orientalis*) with almost unspotted underwing and rump; and pure white axillaries' (Ibis 1924, p. 130). With us in India the Curlew is a shy bird but not always unapproachable and a fair number are shot, especially when they are feeding with other waders, but in its summer home and when breeding it is one of the wildest birds imaginable and, long before one can get within distance even for observation, it rises with its loud screaming note and disappears. Its ordinary call is the well-known haunting cry from which it takes its name, a wild but very sweet 'Cur-lew, cur-lew.' In addition to this, it has a musical note sounding rather like 'What-what.' The Curlew is one of the birds which seem to feed all night. Sometimes, when in Finland and Lapland, I have been watching Nature by the midnight sun between the hours of 11.0 p.m. and 2.0 a.m.; a curious hush seems to come over everything as if even the birds considered it time to rest in spite of the bright daylight. Every now and then, however, this weird stillness would be broken by the wail of the Curlew as it flew overhead from one feeding place to another and, undoubtedly these birds continue to feed all through the night. They eat almost any small living thing: insects, reptiles, coleoptera, slugs, worms and grass-hoppers. They also at times eat seeds, berries and shoots of various plants and seaweed. Its flight is very powerful and swift and our Winter visitors are certainly worthy of the status of game birds, for they are hard to get near to shoot, difficult to bring down and excellent eating when shot.

NUMENIUS ARQUATA ORIENTALIS.

The Eastern Curlew.

Numenius orientalis.—Brehm., Handb. Vogl. Deutsch., p. 610, (1831) (East Indies).

Numenius arquatus.—Blanford and Oates, iv, p. 252, (part)

Numenius arquata lineatus.—Stuart Baker. Fauna, B.I., Birds, vi, p. 202, 1929.

Vernacular Names.—Goar, Gough, Barra Gulinda (Hind.) Choppa, Sada Kastachura (Beng.); Borinda (Sind).

Description.—Differs from the preceding bird in being lighter, more fulvous, less brown above; the lower parts are streaked with much finer, paler streaks; the lower back and rump are often almost unstreaked white and are never barred as in some specimens of *N. a. arquata*; the axillaries are pure white or very lightly streaked on the longest only.

Colours of soft parts, as in the typical form.

Measurements.—Wing, ♂ 280 to 297 mm. ♀ 300 to 314 mm.; culmen ♂ 137 to 159 mm. (one Calcutta 167 mm.) ♀ 135 to 194 mm.

Distribution.—From Baikal to Kirghis Steppes and West Siberia. In Winter south to the whole of India, Burma, China, Philippines, etc. In India it occurs on all the coasts commonly as

far south as Ceylon and also inland wherever there are large areas of swamp and lake, extending to the extreme West in Sind and the N.-E. Frontier Provinces and Punjab. It has been recorded also from the Sudan.

Nidification.—Taczanowski describes the nests and eggs of the Eastern Curlew as indistinguishable from those of the Western bird, nor do they seem to differ in size. The only eggs in my own collection are some taken by Smirnov, who took many clutches at Krasnoyarsk and Yenesei, which he attributed to the Common Curlew but which must of course have belonged to the Eastern race. Hartert says that this form of Curlew breeds throughout Dauria in the Eastern Baikal district and West Siberia to Trans-Caspia and the Eastern Kirghiz Steppe, whilst Witherby gives the limits of the Common Curlew as the Russian Kirghiz Steppes. *Numenius cyanopus* breeds much further to the East, whilst the Slender-billed Curlew also breeds in Trans-Baikal eastward but is a much smaller bird. It therefore seems certain that Smirnov's eggs generally refer to our present sub-species. According to Smirnov the clutches, as one would expect, are all of four eggs and were all deposited on the ground on flat marshy land close to the Eastern banks of the Yenesei River, the one set taken at Krasnoyarsk being of course considerably to the West of this. All my eggs are rather dull and uninteresting specimens, one set of four, however, being paler than the others. They can all be exactly duplicated by eggs of the Western Curlew. Sixteen eggs average 65.4×47.0 mm., maxima 73.2×48.5 and 70.6×50.1 mm., minima 62.1×44.6 and 63.6×41.9 mm. The earliest were taken on the 24th of May and the latest on the 16th of June. Judging by the way in which they are blown, they were all quite fresh but Smirnov says that he saw young birds at the end of June.

Habits.—In India, the Eastern Curlew may be found in some numbers in the huge river deltas in the north of the Bay of Bengal whence it extends in lessening numbers as far south as Ceylon. It is more of a sea-coast than river bird during the cold weather but it may be found also inland in swamps and sandy banks of the larger rivers, whilst I have twice shot it in Bengal in rice-fields when out snipe-shooting. In Assam, it was not uncommon and, it is interesting to note, that its migration route seemed to be from one range of mountains to another and not along the course of the big rivers such as the Brahmapootra until these debouch into the plains. Thus, when in North Cachar on the higher mountain ranges running up to some 7,000 ft., I frequently heard these birds flying overhead at night, following a direct north-to-south course, indicating that they had come straight across the Brahmapootra from ranges to the north of that river. When they first arrive, the birds are not wild, and I have seen birds so tired that they allowed of approach within some 20 yards. Later on in the season they become much more wild and are then difficult to approach. They occur with us either singly or in very small parties not exceeding half a dozen, and they may be seen feeding either in the swamps or standing idly on sandbanks in the bigger rivers. As regards notes, flight, food, etc., I have been able in no way to distinguish between the Western and Eastern forms of Curlew.

NUMENIUS PHÆOPUS.

Key to Subspecies.

- A. General colour paler; dark bars and streaks less heavy ... *N.p. phæopus.*
 B. General colour darker; dark bars and streaks broader and more numerous ... *N.p. variegatus.*

NUMENIUS PHÆOPUS PHÆOPUS.

The Whimbrel.

Scolopax phæopus.—Linn., Syst., Nat., 10th ed., i, p. 146 (1758) (Sweden).

Numenius p. phæopus.—Blanf. and Oates, iv, p. 253 (part). Stuart Baker, Fauna. B.I., Birds, vi, p. 203, 1929.

Vernacular Names.—*Chota goungh*, *Chota gulinda*. (Hind.)

Description.—Head dark brown, the feathers edged with whitish; on either side of the crown the white is obsolete and the dark centres form two dark brown patches, leaving a median pale coronal line and two supercilia pale brown like the forehead; a small brown patch in front of the eye; lores, sides of the head and whole neck brown, each feather with broad whitish edges; upper plumage dark brown with pale brown edges forming bars on the scapulars and inner secondaries; rump and upper tail-coverts white, marked with brown in varying degree as in the Curlew; tail light brown banded with black and the lateral feathers with white tips; lower parts white, the neck, breast, flanks and under tail-coverts streaked with brown, axillaries white with dark brown bars.

Colours of soft parts.—Iris hazel or dark brown; bill dark horny-brown, fleshy-pink at the base of the lower mandible; legs and feet greenish-grey.

Measurements.—Wing, ♂ 232 to 250 mm., ♀ 243 to 265 mm.; tail 87 to 99 mm.; tarsus about 50 to 61 mm.; culmen, ♂ 76 to 86 mm., ♀ 80 to 99.

Young birds have the feathers of the mantle notched and edged with pinkish-buff and the rump suffused with the same; the feathers of the lower back, rump and upper tail-coverts finely edged with brown.

Nestling in down.—Like that of the Curlew but with central streak of buff and two broad lateral streaks of brown on the crown from the forehead to the nape.

Distribution.—Breeding Northern Europe, Iceland, Greenland to Western Siberia. South in Winter to Northern Africa and the eastern coast as far as Madagascar; Arabia and North-West India.

Nidification.—All over the greater part of its breeding range, which extends throughout Northern Europe to Western Siberia, the Whimbrel breeds during the latter half of May and early June and even in its northern haunts, where the snow lies on the ground until the end of June, I have taken eggs hard set on the third of that month and the local Lapps and Finns told me that they had often taken their eggs in snow of some depth. In Northern Lapland they

are extraordinarily common and twenty or thirty pairs may be found breeding on a swamp, a couple of miles long by about a mile broad. They are not nearly so shy as Curlew and with a little patience the birds may be easily watched back on to their nests after they have been once disturbed. This is indeed the easiest way to find their nests, for although once found the eggs look very conspicuous, they are very easy to miss. Most of the nests we found in Lapland were mere scratchings in the ground on slightly raised, exposed, comparatively dry ground in the favourite feeding swamps of that country. No nests were made, although in a few cases a certain amount of dry grass and lichen seemed to have been accumulated in the hollows. Most nests were placed in natural hollows in the reindeer moss which, clear green grey and white as it was, agreed extraordinarily well in general tone with the colour of the eggs of the Whimbrel. Occasionally the eggs may be laid in a scratching on bare soil, and in these cases the eggs can generally be seen at a distance of some yards away and are consequently easy to find. The actions of the Whimbrel when returning to its nest are well worth watching. When first disturbed, the bird gets up and flies away to a considerable distance uttering a harsh loud call but, if one sits down quietly close by, within a very few moments the hen bird certainly, perhaps both birds, return, flying round in circles which gradually decrease in size until one or both birds alight within a couple of hundred yards of the nest. From this point they casually approach their eggs, not in a direct line, but in zigzag fashion, feeding as they come and every now and then taking short flights which generally bring them to a point closer to their nest. Finally, having satisfied itself that there is no danger, one of the pair walks quietly on to its nest and after arranging the eggs to its satisfaction, sits down and begins to brood. As a rule the other bird of the pair remains about a hundred yards away, apparently feeding and taking no interest in what is going on but actually keeping a keen lookout on everything around it. A hundred eggs average $58.9 \text{ mm.} \times 41.3 \text{ mm.}$; maxima $65.1 \times 43.7 \text{ mm.}$ and $57.0 \times 44.0 \text{ mm.}$; minima $52.0 \times 41.0 \text{ mm.}$ and $55.3 \times 36.0 \text{ mm.}$ The eggs are small editions of those of the Curlew but I have seen a few varieties which are uncommon in those of that bird. One of these types has a ground colour of quite bright green blue, handsomely marked with bold blotchings of black or blood-red, and a second type is a pale greenish yellow with innumerable tiny specks and spots of grey brown and chestnut brown. A third type which is quite common in the Whimbrel's egg, though so rare in that of the Curlew, is one which has the markings all accumulated at the bigger end of the egg, forming either a ring or a cap, whilst the rest of the egg is almost immaculate.

According to the local Lapps, the male Whimbrel does the greater part of the incubation though it is relieved at times by the female. Later, when the young are advanced, the male seems to assume sole charge and it is said that the female Whimbrel migrates south some days in advance of the male, who remains behind to give the last touch of education to their young, whom he then accompanies south. The same is said to be the case with the Curlew and the Godwits.

Habits.—The habits of the Whimbrel are so much like those of the Curlew that it is difficult to add anything to the account of that bird. It is a very common Winter visitor to the North-West and West of India, occurring as far South as Ceylon. It is, like the Curlew, for the most part a coastal bird, though it may be found as well on the larger swamps and rivers. In Sind Ticehurst says that the Whimbrel arrive in the first week in August and from then on to the middle of September, when it is very common on the coast. He says: "Their arrival is looked for by the more ardent sportsmen at Karachi since, as they flight to and from their feeding-grounds in the creeks, they afford capital sport and are, moreover, excellent eating. By early October the main body have departed; I have notes of small lots up to 7th November, and occasionally in Winter. It seems scarcer on Spring passage. I have noted it in the second week of May, but quite a number over-Summer (as Butler also noted), frequenting the mangrove creeks, where I have met with it all through June and July. At high water it may frequently be seen perched up on the top of a mangrove bush, a habit Hume also noted in the Andamans. I have seen it at the fresh-water swamp at Karachi, and it occurs on the inland waters of the province during its passage."

Birds shot in mid-June have commenced their complete moult; migrants newly arrived (adults in August, young in September) had not begun to moult. These Sind birds are more spotted on the lower back and rump than most western European ones, but not so much as in *variegatus*.

The call is very like that of the Curlew but more prolonged and trilling and I think it is a more noisy bird, but this may be merely because where found, it is so very common, and therefore more in evidence. When migrating, Witherby says that its presence is often revealed by its clear, tittering cry of 'Tetty, tetty, tetty, tet.' Its food and flight are similar to those of the Curlew.

NUMENIUS PHÆOPUS VARIEGATUS.

The Eastern Whimbrel.

Tantalus variegatus.—Scop., *Dei. Flor. et Faun., Insubr., fasc., ii* p. 92 (1786) (Luzon).

Numenius phæopus.—Blanf. and Oates, iv, p. 253 (part).

Numenius phæiceps variegatus.—Stuart Baker, *Fauna B.I., Birds, vi,* p. 204, 1929.

Vernacular Names.—None recorded.

Description. Differs from the preceding bird in being much darker with more brown and less white; the lower back, rump and upper tail-coverts are much more heavily barred with brown and the striations on the lower plumage heavier; the flanks and under tail-coverts are broadly barred with dark brown as well as streaked; axillaries and under wing-coverts white profusely barred with dark brown.

Colours of soft parts as in the Whimbrel.

Measurements.—Wing, ♂ 231 to 239 mm., ♀ 227 to 239 mm.; tail 89 to 100 mm.; tarsus 60 to 64 mm.; culmen, ♂ 77 to 84 mm., ♀ 83 to 90 mm.

Distribution.—Breeding East Siberia, migrating south in Winter to China, the islands from the Celebes to Sumatra, Indo-Chinese countries and Malay States, and casual in Burma. On the east it is found as far as New Guinea, Australia and Tasmania.

Nidification.—There is nothing on record so far as I can ascertain, and the only eggs I have seen were those taken by Smirnov, one clutch on the Yenesei, and two clutches, each of four eggs, somewhere near Station Echo in Manchuria. In appearance they are indistinguishable from those of the Common Whimbrel, and they were said to have been taken on swampy tundra and lake country in early June.

Habits.—The Eastern Whimbrel is a common Winter visitor to the Indo-Chinese countries and Burma and probably also to Assam and Eastern Bengal, its occurrence having been noted merely as that of the Common Whimbrel. I shot one bird of this race on a small lake in North Cachar in 1899, which had been in the company of two others, and I saw a small flock in Lakhimpur in 1900 which would not allow me within shot, as it was in the company of a particularly wild flock of Golden Plover. In its general habits this bird differs in no way from the Western form. Both Curlew and Whimbrel may be considered really sporting birds, for they have all their attributes, difficulty of approach, speed of flight and the third requisite, excellent flesh for the table.

GENUS: LIMOSA.

Limosa Brisson, Ornith., i, p. 48, v, p. 261 (1760).

Type by taut., *Scolopax limosa* Linn.

In this genus the bill is long and straight; both mandibles are grooved, the linear nostrils being placed near the base of the bill in the upper groove; the tarsus is moderate in length, partly shielded both in front and behind, the hind toe is well developed and there is a web between the outer and middle toes but only a rudiment of one between the middle and inner toe; the middle toe is dilated and sometimes pectinate on the outer side; the wing is long and pointed with the first primary longest, the tail is rather short and almost even.

The genus is cosmopolitan, two species visiting India in the cold weather.

Key to Species.

- A. Base of tail white, terminal half black ... *L. limosa*.
- B. Tail barred black and white over the whole of the outer rectrices and most of the central ... *L. lapponica*.

LIMOSA LIMOSA.

Key to Subspecies.

- A. Larger; wing 210 to 240
mm.; culmen 85 to 126
mm. ... *L. l. limosa.*
- B. Smaller; wing 176 to 207
mm.; culmen 77 to 87
mm. ... *L. l. melanuroides.*

LIMOSA LIMOSA LIMOSA.

The Black-tailed Godwit.

Scolopax limosa Linn., Syst. Nat., 10th ed., i, p. 147 (1758) (Sweden).

Limosa belgica—Blanford and Oates, iv, p. 254 (part).

Limosa limosa limosa.—Stuart Baker, Fauna B.I., Birds, vi, p. 205.

Vernacular names.—*Gudera*, *Gairiya*, *Jangral*, *Khag* (Hind.), *Mal-guiha* (Nepal); *Jaurali* (Beng.); *Gondu ulanka* (Tel.).

Description.—*Breeding plumage*. A pale rufous supercilium from the bill to the ear-coverts; forehead, crown and nape dark rufous streaked with black; lores rufous speckled with black; chin and throat whitish or pale rufous; neck all round rich rufous; back, scapulars and innermost secondaries blackish, broadly barred with pale rufous and edged with white at the tips of the feathers; lower back brownish-black; upper tail-coverts white with black tips; tail blackish, white at the base, the white narrow on the central tail-feathers, broad on the outer; all the feathers tipped whitish; innermost wing-coverts blackish next the scapulars; median and greater coverts grey-brown, bordered with white, forming a broad wing-bar on the greater coverts; primary coverts brownish-black, tipped with white; primaries dark brown, paler on the inner webs, with a wedge-shaped indistinct white mark on the first primary, becoming white on the succeeding primaries and at the same time restricted in extent and forming a white base to the 4th, 5th and 6th primaries; outermost secondaries blackish with white bases and white tips; intermediate secondaries brown with narrow pale edges; breast rufous, barred with black; abdomen and posterior flanks rufous, heavily barred with black and with white bases and narrow white fringes; under tail-coverts white barred with black; axillaries and under wing-coverts white.

Colours of soft parts.—Iris hazel or dark brown; bill dull orange-red or dusky-orange, more red at the base and dusky at the tip; legs and feet greyish-green.

Measurements.—Wing, ♂ 210 to 226 mm., ♀ 215 to 240 mm.; tail 74 to 89 mm.; tarsus 75 to 82 mm.; culmen, ♂ 88 to 107 mm., ♀ 104 to 126 mm. (Witherby.)

In Winter the upper parts are dark brown or blackish, each feather edged with fulvous; the neck more rufescent, with the dark centres obsolete; chin, throat and face pale fulvous, deepening in colour on the fore-neck and tinged with rufous-grey, thence paling to white on the abdomen and under tail-coverts.

Females are like the male but do not always assume so fully rufous a summer plumage.

Nestling down of upper parts buffy or greyish-white, grizzled more or less with brownish; crown and a line from the upper mandible light brown; a buff supercilium meeting behind the crown; a broken brown dorsal line to the uropygium; under parts greyish-white.

Distribution.—Northern Europe from Iceland, Holland and South Finland, Hungary and Russia to Western Asia probably as far East as Lake Baikal. In Winter South to Africa and North-West India. Common in India in the North-West and thence becoming scarcer towards the South though it has occurred in Ceylon. To the East it has been obtained in the United Provinces and Western Bengal.

Nidification.—The Black-tailed Godwit breeds in Northern Europe and Asia, probably as far East as the Baikal district, although its exact limits are not yet known. In Russia, according to Witherby, it breeds as far North as Lat. 60° but it also breeds South, probably down to about Lat. 45° . It makes its nest in or round about marshes and on the shores of lakes, whilst in Holland it is said also to breed amongst the bushes and scrubby grass of the sandhills. The favourite site, however, is undoubtedly the rank grass of swampy muddy land round marshes and the nest, as a rule, is very well hidden and difficult to find except by the watching of birds on to the nest. The nests are said to be quite well made, pads of grass or blades of rushes placed either in natural hollows, or in amongst the roots of the grass. The eggs are almost invariably four in number and are not unlike the eggs of the Whimbrel but are generally easily recognised for, whereas the eggs of the Whimbrel are nearly always more or less pegtop in shape, the eggs of the Godwits are longer, narrower and less pointed, moreover most are duller and less boldly marked than the eggs of the Whimbrel. The texture is perhaps slightly less smooth and polished. At the same time unusually-shaped eggs of either species may be met with, which are very difficult to assign to one or the other. The ground colour may be anything from a palish olive-ochre, olive-brown or olive-green to a rather dark shade of the same, whilst the markings consist of very numerous small blotches and freckles of dull umber-brown, ochre-brown or grey-brown distributed almost equally over the whole surface and nearly always rather dull and indistinct. Jourdain gives the measurements of 100 eggs as follows. Average, 54.7×37.3 mm., maxima 59.8×37.8 and 53.3×40.7 mm., minima 48.5×37.7 mm., and 55.0×34.0 mm.

They are early breeders and eggs may be found as early as the middle of April and from then onwards throughout May over most of its breeding area, whilst in Iceland the breeding season may be taken as about a month later. As with the Curlew and Whimbrel, so with the Godwit; both sexes share in incubation and it is probable that the male does the greater part. The period for which they sit is said to be 24 days, whereas that of the Curlew is 30 days and that of the Whimbrel 25 or 26 days. It is recorded also that the male bird is the better parent of the two in feeding and looking after the young.

Habits.—The Godwit arrives in the North of India about the first week in October, leaving again during March and April but in North-West India it is said to arrive sometimes as early as August. In the North-West it may be seen in very large flocks but in the North-East it will be seldom seen in flocks over a dozen, though I once saw a flock in Nadia, Eastern Bengal, in which there must have been fully a hundred birds. Whilst they may be found in any kind of marsh or river, they seem to prefer the margins of swamps or lakes and during the winter they are certainly much less sea-shore birds than are Curlew and Whimbrel. It is just as sporting a bird as is either of the two just mentioned; as difficult to approach, as hard to shoot when one has got within shooting distance, while it is equally good to eat. One of the biggest bags I ever made in one shot was as a youngster in Bengal when, after considerable time and trouble, I succeeded in getting within a shot of a flock of these birds, my two barrels gave me a net bag of seven Godwit, a great many cows and the cow-keeper, a shot which had to be paid for to the tune of what was to me then a large sum in rupees, though there were no fatalities other than among the Godwit.

The food of the Godwit is much the same as that of the Curlew but Ticehurst found that those he shot in Sind had been feeding entirely on crustaceans and on what was apparently a water beetle.

Before they leave us a great many birds have assumed their summer plumage, either in part or in toto and, more especially in Western India, a few birds linger within our area throughout the summer. Their cry is a musical trisyllabic whistle, sounding like 'Whist, whit, twit,' and it has a low single note, the only one we hear in India, as it rises from the ground and when it again settles.

LIMOSA LIMOSA MELANUROIDES.

The Eastern Black-tailed Godwit.

Limosa melanuroides Gould, Birds of Australia, pt. xxxiv, vol. vi, pl. 38, (Port Essington, Australia).

Limosa limosa melanuroides Stuart Baker, Fauna B.I., vi, p. 207.
Vernacular Names.—None recorded.

Description.—Resembles the preceding race but differs in being rather smaller with a shorter bill. In the breeding plumage the colouring is perhaps a trifle richer, the rufous deeper and the dark bars more black, less brown.

Colours of soft parts as in the typical form.

Measurements.—Wing, ♂ 176 to 197 mm., ♂ 182 to 207 mm., tail 68 to 86 mm.; tarsus 66 to 73 mm.; culmen, ♂ 77 to 95 mm., ♀ 78 to 87 mm.

Distribution.—Eastern Siberia to Japan. In Winter, south to Eastern India, Burma, China, the Malay Archipelago and Australia. Exactly where the two races merge into one another is not known but probably somewhere about Lake Baikal. In Burma it is not rare in Winter and it occurs in Calcutta and Eastern Bengal, whilst numbers visit Assam yearly.

Nidification.—At present there is nothing recorded in regard to the nidification of this bird but Smirnof obtained eggs of a Godwit in

Northern Manchuria which he believes to have been those of the present species. In appearance they are indistinguishable from the eggs of the Bar-tailed Godwit but are even smaller than those of that bird. Two clutches sent to me average only 52.8×36.1 mm. As the bird itself is smaller than the Bar-tailed Godwit, the eggs are probably correct. Both these clutches are now in my collection and are of a dull, almost unicolour type. They were said to have been taken in swampy tundra on the 4th and 16th of June.

Habits.—This bird is quite common during the cold weather in Eastern Bengal and Assam, where I have shot numbers for the pot. It occurs as a rule in small flocks, generally half a dozen to 20 or 30 but, just after and just before migrating, it often collects in very large flocks and I have seen some of these numbering as many as 200 and, once, one of probably twice that number. Our first arrivals in Assam generally appeared in early September, but the greater numbers not until well on into October. By April the small flocks began to join up and before the 15th of that month the last had disappeared, with the exception of a few birds, probably non-breeding ones, which might be seen in June and July and which probably did not migrate at all to the northern breeding grounds. In Eastern Bengal it is quite as common as in Assam and it is of course found throughout Burma from the north to the extreme south of Tenasserim. How far South it occurs in India I have been unable to trace. It certainly occurs as far south as the Chilka lake in Orissa but south of that I can find no record. It is quite a sporting bird in its shyness and speed of flight and it is such an excellent bird for the table that it is well worth while stalking. Its diet is probably mainly animal, consisting of all kinds of insects, small mollusca and various small worms which it obtains by probing in the deep mud with its long bill. In Assam, however, several birds which I examined seemed to have been feeding on grass seeds and a tiny black seed of a water plant which was very plentiful in the swamps. The only cry I heard was a very pleasant triple note, sounding like 'Tir-ree-wee' twice repeated as the birds rise and occasionally as they wheel and circle in the air. It is said also to have a single loud harsh call but this I have not heard.

LIMOSA LAPPONICA LAPPONICA.

The Bar-tailed Godwit.

Scolopax lapponica Linn., Syst. Nat., 10th ed., i, p. 147 (1758) (West Europe).

Limosa lapponica.—Blanf. and Oates, iv, p. 256.

Limosa lapponica lapponica Stuart Baker, B.I., Birds, vi, p. 208, 1929.

Vernacular Names.—Same as for *L. l. limosa*.

Description: Breeding plumage.—Crown and lores rufous with black streaks; supercilium, sides of head, whole neck, breast and under plumage rich rufous; feathers behind the eye and a line down the hind-neck streaked with black; mantle and inner secondaries rufous with broad central streaks of black, these dividing the rufous on the inner secondaries into notches; lower back, rump and upper

tail-coverts white, more or less streaked with black, the longest coverts suffused with a little rufous; tail barred black and white throughout, the central tail-feathers slightly suffused with rufous; primaries black with white shafts and the 1st to 6th or 7th mottled with white on the base of the inner webs, remaining primaries black with narrow white internal edgings; outer secondaries brown-grey with white edges and a white inner streak following the contour of the feather; axillaries and under wing-coverts white with black streaks.

Colours of soft parts.—Iris brown; bill pinkish flesh-colour, the terminal half horny-brown to almost black; legs and feet greenish-grey to almost black.

Measurements.—Wing, ♂ 202 to 216 mm., ♀ 211 to 227 mm.; tail 66 to 77 mm.; tarsus 46 to 51 mm.; culmen, ♂ 72 to 83 mm., ♀ 95 to 106 mm. (Witherby.)

In Winter the rufous disappears; the upper parts are brown, each feather edged with fulvous; the wing-coverts are broadly edged with pale fulvous; chin and throat albescent; fore-neck and breast fulvous-brown, with a pinky tinge and faintly streaked with darker brown, the streaks more distinct on the flanks; abdomen and under tail-coverts white or fulvous-white; the sides of the head pinkish-fulvous, much streaked with dark brown.

Females are similar to the male but do not always assume so complete a breeding plumage.

Young birds in the first autumn have the upper parts more marked with buff spots, which also form notches on the inner secondaries.

Nestling like that of the previous species but less pink in general tone and with the coronal and other dark marks better defined.

Distribution.—Breeding in Northern Europe from Lapland and North-East Finland to the Yenesei in Asiatic Siberia and probably as far East as the Taimyr Peninsula. In Winter it migrates south to Africa and the Mekran coast, Sind and Cutch in North-West India.

Nidification.—The Bar-tailed Godwit is a very early breeder when one considers the climate in which it nests. Many birds lay as early as the middle of May, when the swamps are still half-frozen and snow still covers the ground in all directions. In Northern Lapland they breed in the same swamps as the Whimbrel and many other waders but whilst the Whimbrel lay their eggs absolutely in the open on caked mud or reindeer moss, etc., the Godwit seems always to select thin grass in which to make its nest and, though once found, the eggs seem very conspicuous, they are to a slight extent concealed by the surrounding grass and would certainly escape the notice of a careless observer. This year, 1931, I have been fortunate enough to be able to visit the Lapland breeding grounds of this Godwit, which was really quite common in some of the swamps. As with all our waders, it seemed to be very capricious in its choice of a breeding site. I remember one day we visited no less than four swamps, each of which to the human eye seemed exactly the same, vast stretches of horrible quaking bog, dotted here and there with little hummocks and small flats of comparatively dry ground. All round them stunted fir and birch grew fairly thickly, whilst the surface of the swamp itself was

more or less covered with water weeds, thin struggling grass and, in places, thicker vegetation such as salix and kindred plants. In three of these swamps bird life was conspicuous by its absence and not a single Godwit was to be seen, yet in the fourth, everywhere we went, waders large and small were busy carrying on domestic duties and among them were some four or five pairs of Bar-tailed Godwits, two of whose nests we were fortunate enough to find. Both nests contained four eggs but whilst in one the eggs were absolutely fresh, in the second, the eggs were at least fifteen days incubated. This was on the third of June; a bitter North-East wind was blowing and driving dense masses of falling snow almost horizontally across the landscape. In these out-of-the-way places we did not find the Godwit very wild and the birds would return to their nests within a short time of our putting them up; at the same time they were decidedly wilder and much more wary than the Whimbrel and would try to lure us from their nests by alighting in front of us, piping loudly and then flitting off in the opposite direction to that in which their nest lay. We were very much interested to find from the very large series of eggs we were able to examine, that the oft-repeated assertion that it is comparatively easy to distinguish between the eggs of the Bar-tailed and Black-tailed Godwits, is not correct. In size the eggs of the two birds overlap considerably, the texture is in no way different, whilst the colour is a totally unreliable guide, as every range of colour to be found in the eggs of the Black-tailed Godwit is also to be found in those of this species. On an average of course the eggs are very much smaller, that of 111 eggs being 53.4×37.3 mm.

Habits.—This Godwit is common on the coasts of Sind in the cold weather and of course also occurs on the Mekran Coast. Most birds arrive in August and September, leaving again the following April but, occasionally they come in much earlier and Ticehurst has recorded them as early as the 22nd of July. He also notes that the birds may be seen both singly and in small flocks in the grey non-breeding dress but those which are purposing to migrate, have mostly attained their semi or complete summer plumage. As with others of the larger waders, the birds which stay the summer through are probably young of the previous year who are not breeding, but it is remarkable that one bird obtained by Ticehurst on the 20th of April was in full breeding plumage with the exception that it had retained some traces of its juvenile colouration in the tertiaries; so, occasionally at all events, some birds do attain this plumage the first year. Ticehurst also records the fact—and this is also endorsed by Eates and other observers—that the majority of the birds on arrival in Sind are still in complete breeding plumage, which they at once begin to moult for their winter attire. In India it seems to be purely a bird of the coastal region, and it may be found some way up the mouths of the larger rivers, especially where these have brackish water and extensive mud banks. They are extraordinarily shy, wild birds and very difficult to approach, the more so in that they invariably seem to keep to wide open spaces; moreover, they are generally to be found feeding and wandering about in mud, generally of some depth and sometimes unpleasantly treacherous. Their call is a pleasant low whistle, or, as Hume

describes it—'a low piping note.' Sometimes this is rapidly repeated, more especially if the bird is frightened, but as a rule it is a single note, uttered as the bird rises and again as it descends. Their courtship song is perhaps less musical than that of some of the smaller waders, but it is quite sweet and soft, consisting of rapidly uttered notes, not unlike their winter cry, but softer. The flight, of course, differs in no way from that of the Black-tailed Godwit, whilst its food appears to be the same. The birds examined by Hume had fed chiefly 'on tiny shrimp-like things, small mollusca, sand worms and insects, but most of their stomachs contained matter that I took to be minute acephalæ, or jelly fish. I found no vegetable matter in any of their gizzards, and the flesh of two or three that we cooked, hoping to find them as good as the other species, was by no means well flavoured. It was not fishy, but it had a faint, froggy flavour, and reminded me of that of eels caught in muddy broads and dykes at home.'

My own experience of the Godwit as a table bird does not agree with Hume's description for I have invariably found them to be excellent in every way, more like snipe than anything else and generally very fat and tender.

GENUS: LIMNODROMUS.

Limnodromus Neuweid., Beitr. Naturg. Brazil, iv, Abst. 2, p. 716 (1833).

Type by mon., *Macroramphus griseus* Gmelin.

In this genus the bill is like that of a Snipe, very long, straight and slender, swollen towards the tip, where it is pitted; both mandibles grooved at the sides from the base to the swollen dertrum, which has a groove on the upper surface; the tarsus is shorter than the wing and is scutellated in front, reticulated behind; the hind toe is well developed and the anterior toes are joined by webs, that between the middle and outer being the larger; the wing is long and pointed, the first primary longest, the second almost as long. The breeding plumage is rufous, the non-breeding grey-brown, extremely like the plumage of *Limosa*. Sexes alike. Of the two species known, one is American and the other is from North-Eastern Asia.

LIMNODROMUS TACZANOWSKIUS.

The Snipe-billed Godwit.

Micropalama taczanowskia Verreaux, Rev. et. Mag. Zool. p. 206, pl. xiv (1860) (Dauria).

Macroramphus semipalmatus,—Blanf. and Oates, iv, p. 257.

Limnodromus taczanowskii, Stuart Baker, Fauna B.I., Birds, vi, p. 210, 1929.

Vernacular Names.—None recorded.

Description: Breeding plumage.—Whole head, neck and lower plumage rufous; lores and a line through the eye so closely tipped with black as to appear uniformly of that colour; a line from the forehead and crown closely streaked with black, leaving a rufous line or supercilium on either side; hind-neck lightly streaked with

black; mantle rufous, each feather broadly centred black, the scapulars, inner secondaries and small coverts edged with grey; lower back and rump white with black centres; upper tail-coverts barred black and white, the longer suffused with rufous; tail barred dark brown and white, the terminal bars blurred and broader; least wing-coverts dark brown; median and others grey-brown-edged with white; quills brown with white shafts, a long wedge-shaped white patch on the inner webs of the first five and extending to both webs on the others; outer secondaries grey-brown with broad white edges; posterior flanks lightly barred with black; axillaries and under wing-coverts white with a few dark brown bars.

Colours of soft parts.—Iris dark brown; bill black, paler and plumbeous at the base; legs and feet dark plumbeous or brownish-black.

Measurements.—Wing, ♂ 160 to 172 mm., ♀ 163 to 177 mm.; tail 61 to 67 mm.; tarsus, 48 to 54 mm.; culmen, 77 to 87 mm.

In Winter the upper parts are dark, rather greyish-brown each feather edged with white, most conspicuously so on the median and greater coverts; the under plumage is white, the sides of the head, chin, throat, neck, breast and flanks speckled with dark brown, the specks becoming bars on the lower breast, flanks and under tail-coverts.

Distribution.—The Snipe-billed Godwit breeds from West and Central Siberia through Mongolia to Japan. It has been obtained by Jerdon in Madras, by Blyth and Hume in Calcutta, by Oates in Pegu, by McMaster at Rangoon, by Macdonald in Dibrugarh and by Wilson in Shillong, in Assam, but doubtless it occurs far more often than it is recognised and shot. Butler recorded it from the Malay States.

Nidification.—The Snipe-billed Godwit breeds in Western Siberia, where its nest and eggs were taken by Dr. Valizkamen in the District of Barnaul. This is a Settlement of some size on the Ob River at a latitude of about 53°40'. The two eggs referred to were eventually obtained and given me by the late Dr. Paul Sushkin and are now in my collection; they are like small eggs of the Common Godwit, rather long pointed ovals in shape, with a pale dull buff brown ground and fairly numerous specks and small blotches of inky brown with a few faint underlying marks of neutral tint. They measure 47.6 × 32.3 mm., and 48.4 × 33.1 mm., and were taken on the 19th of June, 1918. I can find no other record of this bird's breeding, though Emile Smirnov includes the eggs of this Godwit amongst those said to be in his collection.

Habits.—This wader has been found at odd times within our limits over very widely spread areas, as already shown above under the heading *Distribution*. As regards its habits in India, there is absolutely nothing recorded. The bird shot by Wilson in Shillong was in company with a few others on some small wet rice-fields at an elevation of over 5,000 ft., but all the other birds recorded in India have been obtained on the coast or on the muddy banks of the estuaries of the larger rivers. Wilson's birds were probably migrating, for on two other occasions I have seen this Godwit in Assam, once in early September on a marsh, on which were an enormous number of recently arrived snipe and other waders, with whom

these birds had presumably come. We had shot over this swamp the previous day and had not seen 50 snipe, yet the following day when we shot the Godwit, snipe were present in many hundreds, accompanied by a vast number of small waders of many kinds. Two days later, practically the whole of them had left.

On the second occasion I saw them it was late April and all the waders were rapidly moving north towards their breeding grounds, two or three Snipe-billed Godwits among them. On both the occasions I saw these birds, they were walking about and feeding on masses of floating seaweed, over which one could walk, although all the time at some risk of our feet going through the floating weed into the deep water below. The flight resembled that of the Bar-tailed Godwit but was, I think, even swifter and certainly more direct. As far as I can recollect, they uttered no note of any kind but other waders were so numerous and so frequently calling that it would have been easy to have missed hearing these birds had they called.

(To be continued.)

REVISION OF
THE FLORA OF THE BOMBAY PRESIDENCY.

BY

E. BLATTER, S.J., Ph.D., F.L.S.

PART XVIII

(With 4 plates and 1 text-figure.)

(Continued from page 495 of this volume).

ORCHIDACEÆ

BY

E. BLATTER, S.J., Ph.D., F.L.S. & C. McCANN, F.L.S.

28. SACCOLABIUM Blume (not in Cooke).

Epiphytic herbs; stems leafy. Leaves long, linear, sometimes terete. Flowers solitary or in simple or branched, few- to many-flowered racemes, small or moderate sized. Sepals and petals free, spreading, recurved or incurved. Lip spurred, 3-lobed, rarely entire, side lobes short, erect, midlobe fleshy, spur saccate, naked within, or with calli on the front wall only. Column short and broad; foot 0 or indistinct. Anther 1- or imperfectly 2-celled; pollinia 2, entire or 2-partite.

Species a few.—Indo-Malayan.

Saccolabium flabelliforme sp. nov. Blatter & McCann.

[*Affinis Saccolabio pulchello* Fischer a quo tamen differt foliis latoribus acutis minime bilobis, floribus multo maioribus, sepalis petalisque flabelliformiter dispositis labio albo ad basim angulo profundo triangulari flavo ornato, lobis labii lateralibus nullis.]

Description: A small plant; stem very short, arising from beneath the leaves; roots very long, flattened, bluish grey, clinging to branches of trees. Leaves linear or linear-oblong, acute, flat, up to 12 cm. long and about 2–3 cm. broad. Flowers sessile (i.e. ovary not stalked) in few- (usually 6-) flowered racemes, 18 mm. wide by 12 mm. across; bracts broadly ovate, 1 mm. long 2 mm. broad at base, thin, brown. Dorsal and lateral sepals and petals arranged like a fan; sepals and petals apple-green, sometimes with a rose-coloured dot; dorsal sepal oblong-obovate, slightly emarginate and apiculate, 9 by 4 mm.; lateral sepals spatulate-oblong, obtuse, slightly concave, 8 by 3 mm. Petals resembling the lateral sepals, but slightly smaller, slightly concave, 7 by 2.7 mm. Lip without side lobes, 3 mm. long, 8 mm. broad, curved at its extremity with the straight hinder margin as a base (the hinder margin being made up by the straight front edge of the opening of the spur and a short free portion on each side set onto the outside walls of the spur slightly below its edge), slightly deflexed, outer edge minutely fimbriate, tip emarginate, pure white, except the thickening of the spur which is greenish; there is a central deep yellow triangle on base of lip, and the bottom of the spur is similarly coloured, the yellow triangle of lip is bordered with rose-coloured dots and short lines. Spur nearly hemispherical, slightly laterally compressed, with a longitudinal, outwardly convex, inwardly concave thickening, length and side diameter 5 mm., the free lateral edges of the spur slightly ascending outwardly from base to column, the free edge of the spur-cavity marked thinly with purple-rose, and the interior bottom of spur dotted with similar coloured spots. Column white, generally strongly suffused with deep rose, without foot, as broad at base (2 mm.) as the front edge of spur where the lip commences, and about as high as it is broad there, triangular in shape seen from the front, the apex rather broadly rounded, the cap oval, pointed in front, convex with depressed margins, yellow, anticous or inclined (it forms the top of



Del. C. McCann after Miss E. Bell.

Saccolabium flabelliforme Blatter and McCann, sp. nov.

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the column), slanting down towards opening of spur. Pollinia 2, orange-yellow, oval, attached to a caudicle as long as the diameter of both together; gland oval, with a bifid tip which is always visible outside the cap lying on the rostellum and which hides completely the stigmatic hollow. The front-opening leading to the stigmatic hollow triangular owing to the flanged front-walls of the column. Ovary in flower 8 mm. long.

Locality: *N. Kanara*: Devimane Ghat (Sedgwick & Bell 6957! type); Yellapur (T. R. Bell, from sketches, coloured plates and MS. notes); Sirsi, in evergreen (Sedgwick 7078!); in forests (T. R. Bell 5424! 5413!).

Flowers: September 1915 (Yellapur); October 1914 (Sirsi).

29. *NERVILIA* Comm. ex Gaud.

(Under *Pogonia* in Cke. II, 706).

Terrestrial, tuberous, 1-leaved. Leaf mostly appearing after the flowers, broadly cordate to orbicular, plicate. Flowers solitary or few to many, racemose. Sepals and petals subequal, narrow. Lip inferior, adnate to the base of the column, sessile or almost clawed, entire, 2-fid or 3-lobed, sometimes slightly saccate at the base. Column elongate, broadening upwards; foot 0. Anther substipitate; pollinia 2, 2-fid, or 4, powdery; caudicle and gland absent. (ex Fischer).

Species 45.—Tropics of the Old World.

The Bombay species have been put under *Pogonia* Juss. by Cooke. *Pogonia*, with its 40 species is, 2 Chinese-Japanese species excepted, a New World genus.

Cooke mentions 2 species from the Presidency which when put under *Nervilia* have to be called *N. plicata* Schlechter and *N. carinata* Schlechter. To these we add 3 species not known from the Presidency before and 4 new ones.

Hook. f. in his F. B. I. vi, 119 refers to the difficulty he experienced in analysing the species from Herbarium specimens and adds that 'all require revision.'

We have had the advantage of exceptionally well-prepared specimens of leaves and flowers of several species and, in addition, excellent drawings and paintings by Miss E. Bell. Besides, Mr. T. R. Bell was kind enough to put at our disposal his detailed descriptions which he had drawn up from live specimens.

We feel confident, though we are not absolutely sure, that the new species are all good ones. Hooker's descriptions are rather meagre and Wight's illustrations are not always perfect. But taking it for granted that the details given by Hooker are correct, we are allowed to say that the species described below are good. If, however, one or the other is not and if other botanists should think that they should be combined with one of the older ones, our descriptions will at least serve the purpose of furnishing many details which were not known before.

As to the time of appearance of the leaf Hooker f. states (and Schlechter and Fischer agree with him) that all the species of the genus *Nervilia* leaf after flowering. This is not always the case.

I. Scape 1-flowered

- | | | |
|--|-----|-------------------------------|
| 1. Sepals and petals greenish white, sometimes with a rosy shade. Lip broadly saccate, pinkish white | ... | 1. <i>N. monantha</i> . |
| 2. Sepals and petals light maroon-green on back, dirty green inside. Lip very slightly saccate at base; tube light apple-green, midlobe white suffused with rose | ... | 2. <i>N. infundibulifolia</i> |
| 3. Sepals and petals greenish purple. Midlobe of lip obovate, pink, mottled with purple... | ... | 3. <i>N. Hallbergii</i> . |
| 4. Sepals and petals green. Midlobe of lip rhombic-lanceolate-acuminate from a narrow hairy base; disk white mottled with pink | ... | 4. <i>N. juliana</i> . |
| II. Scape 2-flowered. Flowers 30-35 mm. diam. | ... | 5. <i>N. biflora</i> . |
| Lip pale pink | ... | |

- III. Scape 2-3-flowered. Lip lilac with a green spot at the base and a yellow line along the thickened part of the midrib ... 6. *N. plicata*.
 IV. Scape several-flowered. Flowers 14 mm. long, green, except for lilac markings on lip ... 7. *N. hispida*.
 V. Scape many-flowered
 1. Leaf 13- or more-ribbed ... 8. *N. Aragoana*.
 2. Leaf 7-9-ribbed ... 9. *N. carinata*.

1. *Nervilia monantha* sp. nov. Blatter & McCann.

[*Orchidacea appropinquans Nervilium julianum* Schlechter a qua distingui potest folio generatim largiore, sessili vel subsessili, obtuso, multinervoso (11-19), flore multo minore, sepalis petalisque linearibus albo-viridibus roseo-nervosis labii forma distincta colore roseo-albo. Differt a *N. plicata* Schlechter folio viridi, flore unico, colore et forma labii; a *N. biflora* Schlechter flore semper unico, labio minime glabro, columna distincta.]

Description: Tuber subglobose, 25 by 15 mm. or less, depressed above and below, giving off sparse little roots from surface all over, yellowish white, generally 5-10 cm. underground. Two or three stolons from stem between tuber and origin of leaf. Leaf sessile or subsessile, lying flat on the ground and appearing after the flowers, orbicular-cordate, obtuse, with a broad or narrow sinus at base, 11-19-nerved, the size varying between 2 and 10 cm. diam., pure green throughout, upper surface velvety when first expanded, with short fine glandular white hairs, glabrous below. Flowering-stem 7-10 cm. long, fruiting-stem reaching 15-20 cm., very slender, always 1-flowered, light pink, with usually 2 long, wide-mouthed acuminate sheaths, these shorter than the internodes, lighter pink with 7 purplish nerves. Floral bract triangular, subulate, short, not concave, longer than broad, generally 1-1.5 mm. in length, whitish with a green shade, edges reddish. Flowers erect or suberect. Sepals and petals similar to each other in shape and colour, linear-acute, slightly narrower at base than in the middle, greenish white, sometimes with a rosy shade, the nerves rose-coloured. Sepals 5-nerved, 17 by 3 mm., concave, the midvein not particularly prominent on back. Petals hardly shorter, 3 mm. broad, 3-nerved. Lip hardly saccate, 18 mm. long, the lower $\frac{2}{3}$ tubular, 4 mm. broad in middle, about 2 mm. at base, pinkish white, hiding the column, the edges hardly conniving, widening from base upwards, the lower part afterwards produced into a short deflexed terminal lobe which is very wrinkled both round the margin as well as longitudinally in the limb with the margin shortly fimbriate, separated by a deeper cut from a broadish, fimbriate (not always), smaller, 2 mm. long lobe on each side forming the end of the tubular part of the lip, the throat of the tube stretching some way up each side lobe and some way down the tube beset with white soft hairs; lip 7-nerved with other veins outside the exterior ones, the 3 central nerves with a row of purple-pink tubular outgrowths which are simple at the beginning and become longer and branched towards the distal end; the nerves themselves purplish rose, the central nerve light brownish. Column glabrous, stalk quite straight, the anther leaning slightly forward; stalk thickened to contain the stigma which is semi-elliptical, longer than broad, somewhat pointed below, straight at top below anther; edges of anther fairly prominent, the back convex, very slightly keeled down middle, the cap tilted forward a good deal, reaching far above the edges, rather square in form, though longer than broad, sometimes broader across top than at front, depressed down centre at top; the anther-pockets occupying the whole of the bottom which is here at right angles to the front face; the pollinia attached behind, or rather lying with their bases towards the back, these bases dark purple and globular, the pollinia yellow; the pockets are parallel and straight. Length of column 9 mm.; breadth of stalk nearly 1 mm.; breadth of anther a little less than 2 mm., the part of top of column containing the stigma 2 mm. Fruit spindle-shaped with 6 longitudinal ridges; these ridges broad, prominent and rounded in transverse section, 21 mm. by 7 mm., the beak 8 mm., thick and conical, with the withered lip showing as an extra thin point beyond; it is pure green in colour as is also the beak, generally deflexed.

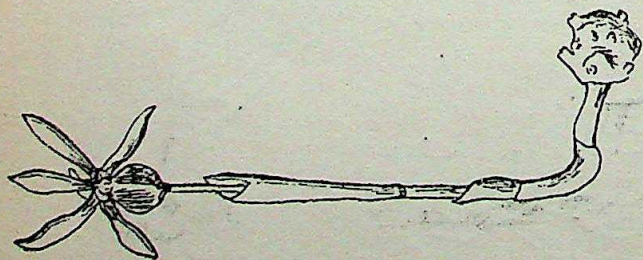
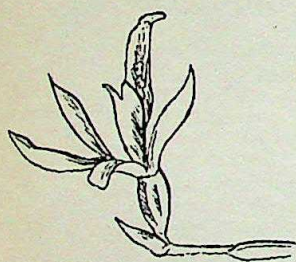
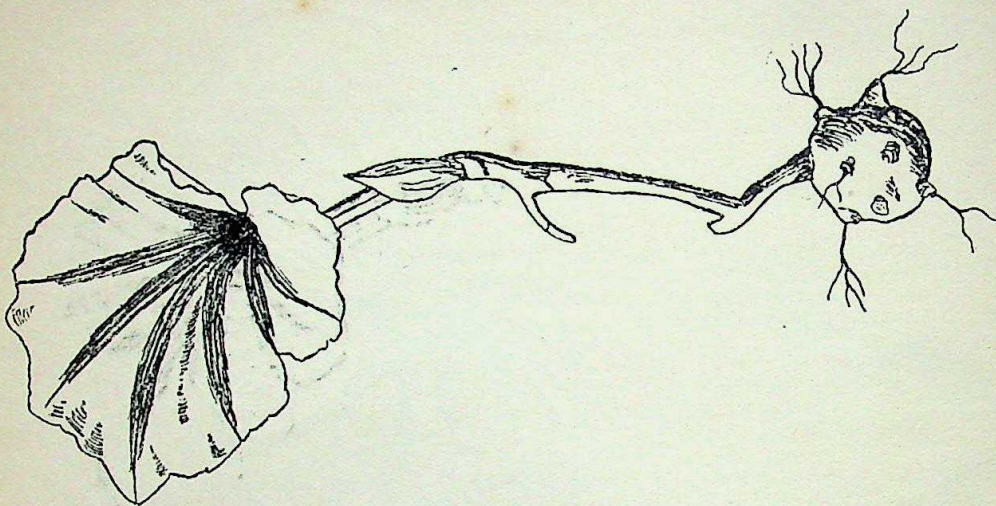
The leaf appears above ground as a thick, short, spindle-shaped bud, covered by a sheath, 25 by 8 mm., pointed. (Chiefly from T. R. Bell's MS. notes drawn up from live specimens).



Journ., Bombay Nat. Hist. Soc.

Del. C. McCann after T. R. Bell and Miss E. Bell.

Nervilia monantha Blatter and McCann, sp. nov.



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Locality: N. Kanara: Yellapur (T. R. Bell 5428! type, 5428a! 5429 5434! 2522-2524!); Nagargali (Sedgwick 2635!); Karwar (T. R. Bell 4071!).—Bell found this species very common in 1911 at the beginning of June after rain round Yellapur in jungle, preferring apparently bamboo jungle where the ground is covered with dead leaves. He found it also in the compound of the D. F. O. bungalow under *Pithecolobium* trees. It is always found under shade and generally comes up in groups.

Flowers: June 1911 (Yellapur).

2. *Nervilia infundibulifolia* sp. nov. Blatter & McCann.

[*Orchidacea similis aliquomodo Nerviliae monanthae* Blatter & McCann, sed facile distinguitur folio infundibuliformi, paucinervoso (5-7-9) petiolato, sepalis 3-nervosis, petalis 1-nervosis, labii lobo medio integro polliniis albis.]

Description: Tuber about 12 mm. in height, slightly flattened above and below yellowish white, buried 3-8 cm. underground, covered sparsely with little root-knobs. The stolons, if any, arise not from the tuber but from the stem below the origin of the leaf. Leaf-bud spindle-shaped, 15 by 3 mm., pointed. Leaf solitary, appearing after ripening of fruit, broadly cordate, funnel-shaped, about 3-4 cm. diam., margin crimped, irregularly and minutely dentate-crenulate, 5-7- or rarely 9-nerved, the last pair generally thin, green with broad deep purple-maroon streaks from base along the depressed nerves, broadening towards the middle, narrowing again towards extremity but not reaching the margin, the margin very finely brown-maroon. Petiole dark brown-maroon, embraced at base by a 5-nerved, membranous, oblong-acuminate sheath which is light brownish and has the nerves purplish, the petiole has as many prominent ridges as the limb has nerves and the ridges are continuous with them. Flowering-stem 7-11 cm. high, straight, consisting of 2 internodes; upper sheath of scape about 3 cm. long, linear-oblongate, acute, wide-mouthed, 5-nerved, with an extra marginal one; lower stem-sheath much shorter than the upper, stem and sheath maroon-coloured. Flower 1, generally at a right angle to the axis or slightly inclined. Floral bract generally 3 mm. long, but may reach even 7 mm., about 2 mm. in width, 3-nerved, acute or acuminate, concave, maroon-coloured, the veins darker. Sepals and petals similar, linear-oblongate, acute, slightly concave, light maroon-green on the back, dirty green inside, the nerves maroon-red. Sepals 3-nerved, 13 mm. in length, 3 mm. broad where broadest. Petals 1-nerved, 12 mm. in length, 2 mm. broad where broadest. Ovary lowly 6-keeled, each more prominent central keel being flanked on each side by a much lower one, maroon-red. Lip very slightly saccate at base, tubular for half its length or slightly less, narrowest just above sac, thence increasing forwards, the edges hardly connivent, parting to show anther slightly, ending on each side in a triangular, rather blunt lobe which overreach in length the column and anther, produced below into the midlobe which is in the same plane as tube, broadly ovate, the margin nearly entire (shows signs of unevenness), the lateral margins deflexed, the extremity rounded, the midvein somewhat broadly gibbous, especially towards the end, though not very prominent (roundly convex in transverse section), beneath channelled along midvein, deeply and narrowly so just before extremity. Length of lip 17 mm., breadth just above sac 2 mm. (less across for the tube is higher than broad), at mouth 3 mm.; the side lobes very slightly spreading, about 15 mm.; long, equilaterally triangular; the midlobe 10 by 7 mm.; the ovary about 4 mm., the pedicel 2 mm. Colour of lip light apple-green for the tube, the side lobes lighter, the midlobe white suffused all over with rose (with a maroon shade in it, medium light in shade) in irregular lighter and darker patches or spots, the midvein for $\frac{2}{3}$ of its length and the margins narrowly white. Column straight, the anther, and (stigma, i.e., the enlarged top half) leaning back, the stalk half the total length, flat in front, rounded behind, covered with short, soft, white hairs for half its length below the stigma on its flat front surface; stigmatic cavity large, occupying nearly half the length of the whole, oval, longer than broad and slightly narrower below than above; the cap occupying the whole top of column, horizontal, the edges of the anther (top of column) only very slightly embracing it, this cap being square when seen from above, concave transversely, straight along front edge above stigma, higher behind than in front; the pockets beneath straight, parallel, containing each one pollinium, lamellated, shaped like a broad sign of exclamation. Column about 8 mm., the breadth of stalk 1 mm.; of anther 2 mm.; the cap hides the whole top of column. Colour

of column light apple-green, of anther whitish, the cap just touched with maroon along its front edge; there are sometimes a few fine longitudinal red streaks on stalk and back of anther; the pollen masses are white. Fruit 6-ribbed, the ribs wide with a more prominent central ridge, beaked with the persistent floral envelope, the column, petals and sepals closely embracing it, the withered end of lip generally protruding as a point from the tip of the beak (the sepals and petals close round the column) completely forming an end cone pointed at extremity. Capsule 11 by 5.5 mm., oblong-oval, the beak another 15 mm. (Chiefly from T. R. Bell's M.S. notes and paintings by Miss E. Bell.)

Locality: N. Kanara: Yellapur (T. R. Bell).—Usually found in places where there is a covering of dead leaves.

Flowers: June 1911.

3. *Nervilia Hallbergii* sp. nov. : Blatter & McCann.

[*Orchidacea referens Nervilium julianum a qua differt labii lobis lateralibus integris, lobo medio obovato et basi minime pubescenti necnon colore.*]

Description: Tuber globose, warty. Leaf not seen. Flowering-stem about 10 cm. high, 1-flowered, consisting of 2 internodes, each with a long linear-acuminate sheath, the upper larger. Flower nodding, bract minute. Sepals and petals spreading, subequal, narrowly lanceolate, greenish purple; midlobe of lip obovate, rounded at tip, pink, mottled with purple, provided with a central white, linear callus; lateral lobes falcate, whitish, folded round stalk of column; no sac or spur. Column pink; anther loose in tube. Pollinia not observed.

Locality: W. Ghats: Kuna near Khandala in jungle (Hallberg, photograph and specimen in formaline at St. X. C., Bombay).

Flowers: June 1917.

4. *Nervilia juliana* Schlechter in Engl. Jahrb. xiv (1911) 402.—*Epipactis Juliana* Roxb. Fl. Ind. iii (1832) 453.—*Pogonia juliana* Wall. Cat. 7399; Hook. f. F.B.I. vi, 119; Trim. Fl. Ceyl. iv, 225.

Description: Tubers globose, 12-25 mm. diam., white; stem 5-8 cm., white, erect; roots few, vermiform arising above the tuber; leaf solitary, developing after the flowering of the scape, petioled, broadly ovate-cordate, acute, about 5 cm. diam., membranous, plicate with 5-7 veins, radiating from the top of the petiole, green or purplish beneath; petiole short, with a few acute sheaths at the base; scape 12-15 cm., with several convolute sheaths, the upper longest. Flower solitary, shortly pedicelled, 2.5 cm. broad; bracts shorter than the ovary. Sepals and petals narrowly lanceolate, acuminate, green; lip longer than the sepals, side lobes small, narrow, falcate, oblong, toothed, white, terminal rhombic-lanceolate-acuminate from a narrow hairy base, white, mottled with pink; disk pubescent between the lobes.

Locality: N. Kanara, in forests (Bell 5437!).

Distribution: Assam, Sylhet, Lower Bengal, N. Kanara, Ceylon.

5. *Nervilia biflora* Schlechter in Engl. Jahrb. xiv (1911) 403; Fischer Fl. Madras pt. viii (1928) 1459; Hook. Ic. Pl.—*Pogonia biflora* Wight Ic. t. 1758; Hook. f. F.B.I. vi, 119.

Nervilia biflora is very incompletely known. Apparently it has been found only once, in the Wynad jungles of the Madras Presidency. The leaf is not known at all, and as to the floral details we have practically only Wight's illustration. We take our specimens from N. Kanara to be this species. They agree in nearly all details with Wight's and Hooker f.'s diagnosis, except where Hooker f. says that the midlobe is crisped and that the sepals and petals are white. Our sepals and petals are light brownish-yellowish with a green shade.

In the meantime Mr. C. E. C. Fischer of Kew Gardens has been kind enough to compare our specimens with the type specimen in the Kew Herbarium. He and Mr. Summerhayes who is in charge of the Orchids of the Herbarium are agreed that our plant is *Nervilia biflora*. A description with drawings has been published in the Ic. Plant. As this work is accessible to few only, we repeat the description in this place.

Description: A stout terrestrial plant. Tuber white with sparse little rootlet-knobs, globose, 17 by 15 mm.; portion of stem between tuber and base of leaf-stalk very short, about 3.4 cm. Leaf ovate-cordate, acute or acuminate, plicate, many-nerved, spread on the ground, shortly stalked or almost without

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stalk, brown-maroon, hairy all over on the upper surface, about 8 cm. long and 6 cm. broad. Flowering stem growing from the sinus of the leaf which lies flat on the ground, 8-10 cm. long, lengthening after flowering to 15-23 cm., greenish white below, and where it is covered by sheaths, becoming, together with ovary, brown-maroon with a green shade towards top; sheaths 2 in number, corresponding to the internodes, about the length of the internodes, linear-obovate-acuminate, 9-veined, soiled greenish white with a brownish shade, the veins darker greenish; internodes ribbed. Flowers 2, one above the other, 30-35 mm. diam. Floral bracts variable in size, 3-6 mm. long, slightly concave, more or less equilateral-triangular, usually entire, sometimes with small teeth at apex, showing signs of longitudinal veins, colour of sheaths. Sepals and petals spreading, similar, narrowly oblanceolate-acute or acuminate, light brownish-yellowish with a green shade. Sepals 27 mm. by 4 mm., somewhat concave, midrib prominent on back, 7-nerved. Petals 23 mm. by 3 mm., 5 nerved, outside nerves sometimes indistinct. Lip slightly saccate at base, tubular for nearly $\frac{3}{4}$ its length, embracing the column completely, narrowest just above basal sac, then gradually widening, the edges closely conniving, pressed against each other forming a keel, then separating gradually and opening wide into the terminal lobe which is really the mouth of the tube widened out obliquely, the contour rounded, very slightly emarginate at end, the margins very shallowly and slightly dentate-crenulate, the midvein prominent and swollen, impressed on the underside leaving the limb inflated on both sides. Length of lip 18 mm., breadth in centre 5 mm., diameter of tube at origin 2 mm. When the lip is flattened out its shape is nearly elliptical with 2 very short insignificant side lobes at about $\frac{1}{3}$ from the base. Colour of lip rose pink, lighter at base and along conniving edges of tubular part, veined darker from midvein outwards, the midvein somewhat broadly white. Column erect, stalked, slightly broader than thick, somewhat concave down front, curved twice, once forward at base, then backwards in upper part. The stalk widens just below anther to contain the concave, transversely elliptical stigmatic surface which occupies about $\frac{1}{4}$ of the stalk-length; the anther above it, about the same width, leaning slightly forwards, straight on its front edge, convex behind with a slight keel down middle, the sides produced upwards slightly higher than the cap which is situated in such a way that this convex part of the column with the keel is visible from above behind it; the cap rather square, convex behind, depressed centrally towards front; pollinia-pockets beneath slightly S-shaped, long, occupying $\frac{2}{3}$ of the length; pollinia lying with their bases forwards, two in each pocket, longly oval, pressed against each other in each pocket, composed of many lamellae; colour of column whitish-rose, the cap rose, red in front, the pollinia-pockets white, pollinia yellow. Length of whole column including anther and cap 10 mm.; breadth of anther 2 mm. No sign of hairs on the column. Fruit spindle-shaped, 6-ribbed, the ribs broad and low, winged along the prominent middle lines, 16 mm. long by 8 mm. broad (across the ribs), the beak of sepals and petals another 18 mm., the withered lip showing as a thin point beyond again.

The leaf appears above ground as a very thin bud, about 17 by 4 mm. and pointed; after thickening rapidly it expands in a very short time.

Very often only one fruit develops on each stem. The plant is gregarious and is nearly always found amongst dead leaves.

Locality: N. Kanara: Yellapur, behind the forest Naka around the root of a tree in jungle, amongst dead leaves (T. R. Bell 6065 ! 6066 ! ter); Tatwal, in large dense jungle (T. R. Bell in MS.); Sirsi (T. R. Bell in MS.).

Flowers: May 1912 (Sirsi); May 1919 (Yellapur); July 1910 (Tatwal).

Fruit: July 1911 (Tatwal).

6. *Nervilla plicata* Schlechter in Engl. Jahrb. xiv (1911) 403; Fischer Fl. Madras pt. viii (1928) 1458.—*Pogonia plicata* Lindl. Gen. & Sp. Orchid. (1840); Hook. f. F.B.I. vi, 119; King & Pantl. in Ann. Roy. Bot. Gard. Calc. viii (1898) 268, t. 358; Cke. ii, 707; Prain Beng. Pl. 1025; Brühl Orch. Sikkim (1926) 157.—*Epipactis plicata* Roxb. Fl. Ind. iii (1832) 454.—*Arethusa plicata* Andr. Bot. Reg. t. 321.

Description: Cke. ii, 707.

Locality: Konkan: Malabar Hill in Bombay Island, Millard's garden (Millard 16723 ! in H. St. X. C.).—W. Ghats: Khandala (Cooke !); Lonavla (H. St. X. C. 26510 !).

Flowers : June 1892 (Lonavla).

Distribution : Konkan, W. Ghats of Bombay Pres., Madras Pres. : Rampa Hills. 1,500-2,000 ft. Mysore, Travancore, Sikkim, Bengal.

7. *Nervilla hispida* sp. nov. Blatter & McCann.

[*Oychidacea vicina Nervilliae* Aragoane Gaud., necnon *N. carinata* Lindl. a priore tamen differt folio multo minore et dense hispido pilis minutis albotuberculato, scapo breviori, floribus minus numerosis et cum folio coetaneis, labio basi aliquantulum saccato, colore viridi, ab altera tamen petiolis multo longioribus, folio hispido nervisque multis praedito.]

Description : Tuber globose, whitish, covered with sparse rootlet-knobs, 20 mm. broad by 17 mm. high. Leaf appearing at the same time as the flowers, broadly cordate, cuspidate, with a wide rounded sinus, thin in texture, finely hispid because of a dense covering of extremely minute, white, tubercular hairs, giving it a shagreened appearance, 4.5 cm. long by 5.3 cm. broad, 13-15 nerved from base, green, plicate between the nerves, margin entire, wavy, the nerves maroon towards base; petiole 13 cm. long from tuber, 11 cm. above ground, maroon-brown in colour, with a narrow smooth rounded channel down the front, ribbed in continuation of nerves of blade. Scape including raceme 10-11 cm. high, 4.5 mm. thick, round, with many fine longitudinal ribs which are not prominent, green with a maroon tinge, except axis of raceme, several-flowered; raceme about 5 cm. long; internodes of scape 2, the lower slightly shorter, the sheath to upper 25 mm. long, shortly pointed, about 11-nerved, dirty light green with a brown shade. Bracts linear-oblong, acute, concave, 12-23 mm. long by 1.5-3 mm. broad, with about 7 nerves, slightly oblique. Flowers green, except for lilac markings on lip, 14 mm. long; pedicel 3 mm. long, the wing-ridged ovary 3 mm. long. Sepals and petals apple-green, similar in shape, linear-oblancoate, acute, 3-nerved, all somewhat concave. Sepals 16 by 5 mm.; petals 15 by 5 mm. Lip very slightly saccate at base, tubular for 10 mm., the rest, 4 mm., being the midlobe, semicircular in outline, the apex mucronate owing to prolongation of midrib. The basal tubular portion is 2.5 mm. just above sac, 4 mm. at end where on each side is a short, rounded side lobe, separated from the midlobe by a shallow rounded sinus; side lobes 1 mm. long, triangular-rounded. The midlobe has the margin curled up all round and is thus cupular, has 3 nerves down the middle beginning at base of lip, all 3 prominent beneath, the 2 side ones the more prominent above; outside the side ones are veins running from them to margin of midlobe and tube; all these veins, except the middle length one are set with soft, white fluff. Colour of lip apple-green, the midlobe having the space outside the 3 length-nerves lilac-coloured on the free exposed portion, the little veins from the side length-nerves to margin being also lilac as far as some way up the tube; when not lilac all veins are darker green than the ground colour. Column whitish light green, the cap lighter and gently tinged with rose, the tinge darkest just at front border; it is nearly straight, clavate at top, flat in front, rounded behind, quite smooth throughout except along the keel on the back of the anther where there is a line of small white hairs; stigma shallow, transverse-oval, straight across top below cap and occupying about $\frac{1}{3}$ of the whole column length; side walls of anther thin and produced slightly upwards free of the cap, but not overreaching it and also out in front on each side of stigma; half the thickness of top of column is visible behind the cap; the cap lies inclined forward at 45°, is nearly square, slightly depressed down centre and produced forward at front edge. Length of column 10 mm., breadth 1.5 mm., the stalk being 6 mm. of the total length; anther 2.5 mm. in width; cap about as broad as the stalk, i.e., 1.5 mm., but is, of course much thinner through; anther pockets parallel, pollinia 2 in each pocket, shaped like a sign of exclamation, each pair pressed together, lamellate, very light yellow in colour. Fruit fusiform with 6 ribs along the whole length.

The tuber is generally 7-10 cm. below the surface in open places under trees as often as not, though also where there is a covering of leaves. The leaf and scape start from the same point of tuber. Later stolons arise from the leaf-base underground.

The leaf comes out at the time of flowering. It shows in the beginning as a somewhat thin bud with a sheath 2.5 cm. long; sheath light maroon, 11-nerved, obtusely pointed and generally with the margins, when showing, thinly maroon. (From T. R. Bell's MS.)

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Locality : N. Kanara : Yellapur (T. R. Bell).

Flowers and fruit : 15th June 1911.

8. *Nervilia Aragoana* Gaud. in Freyc. Voy. Bot. 422, t. 36; Fischer Fl. Madras pt. viii (1928) 1459.—*Pogonia flabelliformis* Lindl. in Wall. Cat. 7400; Gen. & Sp. Orchid. 415; in Journ. Linn. Soc. iii, 40; Hook. f. F.B.I. vi, 121; Duthie in Ann. Roy. Bot. Gard. ix, t. 125; Haines Bot. Bih. & Or. 1163.—*P. Nervilia* Blume Mus. Bot. i, 32.—*P. carinata* Wight Ic. t. 1720.—*Aplostellis flabelliformis* Ridley Fl. Malay Pen. iv (1924) 203.

Description : Tuber subglobose, white, about 2.5 cm. diam.; scape arising from the top of the tuber. Leaf ovate-acuminate or orbicular, cordate at base, 10-14 cm. diam., with 18-20 stronger nerves and as many or more finer intermediate ones; petiole 15-28 cm. long. Flowers green, 18 mm. long, spreading and drooping, up to 15. Sepals 15 mm. long, erect, connivent, lanceolate-linear, acute. Petals 12 mm. long, similar, but with faintly brown nerves. Lip very narrow, 12 mm. long, straight, neither saccate nor spurred, sometimes slightly gibbous, side lobes embracing the column, white, brown-veined; midlobe white, flat, projecting beyond the side lobes, ovate, but not constricted at base; palate hairy with 3 green veins. Column 8 mm. long. Ovary very short, 5 mm. long, winged.

Locality : Konkan : Neral (Herb. St. X. C. 26509 !).—N. Kanara : Sampkhand, 1,600 ft. (Bell & Sedgwick 6966 !).

Leafing : Aug. 1890 (Neral); Oct. 1919 (Sampkhand).

Distribution : Tropical Himalaya, from Garhwal 4,000-5,000 ft. eastwards, Malay Peninsula, Konkan, N. Kanara, Madras Pres. : Rampa, Pulney Hills; Travancore, Malaya, Siam.

9. *Nervilia carinata* Schlechter in Engl. Jahrb. xiv (1911) 404; Fischer Fl. Madras pt. viii (1928) 1459.—*Pogonia carinata* Lindl. Gen. & Sp. Orchid. (1840) 414; Dalz. & Gibs. Bomb. Fl. 270; Hook. f. F. B. I. VI, 121; Prain Beng. Pl. 1026; Hook. f. in Ann. Roy. Bot. Gard. Calc. v, t. 94; Duthie in Ann. Roy. Bot. Gard. Calc. ix, t. 124; Cke. ii, 707.—*Epipactis carinata* Roxb. Fl. Ind. iii (1832) 454; Grah. Cat. 205.—*Pogonia flabelliformis* Woodr. in Journ. Bomb. Nat. Hist. Soc. xii (1899) 519 (non Lindl.).

Description : Cke. ii, 707. A better description in Duthie Fl. Upper Gang. Pl. iii, pt. ii (1920) 217.

Locality : Konkan (Stocks).—W. Ghats : Lonavla (Herb. St. X. C. 26508 !). S. M. Country : Near Dharwar (Law).—N. Kanara : Kulgi, 1,500 ft. (T. R. Bell 6088 !); without locality (T. R. Bell 4072 !).

Flowers : May 1919 (Kulgi); August 1891 (Lonavla).

Distribution : Sub-Himalayan tracts of Rohilkhand and N. Oudh, Kumaon, Bengal, Burma, Bombay Pres., Mysore, Pulney Hills, Cochin.

30. EPIPOGUM Gmelin (not in Cke.).

Saprophytic, leafless, brownish, terrestrial herbs; roots tuberous or coralloid; stem erect, sheathed. Flowers laxly racemed. Sepals and petals subequal, narrow, free, erect or spreading. Lip sessile at the base of the column, broad, entire or 3-lobed, spurred, disk with rows of papillae. Column short; foot 0. Anther thick, dorsally 2-celled; pollinia 2, each with a long, filiform caudicle; gland small.

Species 5.—Old World.

Of this genus which was not known before to be represented in the Bombay Pres., only the following species has been found in N. Kanara.

1. *Epipogum nutans* Reichb. f. in Bonpland. (1857) 36; Lindl. in Journ. Linn. Soc. i, 177; Benth. Fl. Austral. vi, 308; Hook. f. F.B.I. vi, 124; Trim. Fl. Ceyl. iv (1893) 222; King & Pantl. in Ann. Roy. Bot. Gard. Calc. viii, t. 335; Fischer Fl. Madras pt. viii (1928) 1460; Brühl Orchid. Sikkim (1926) 148.—*E. roseum* Lindl. l. c.—*Galera nutans* Blume Bijdr. 415, t. 3; Mus. Bot. II, 187; Orchid. Archip. Ind. 139, t. 52 et 54E.—*G. rosea* Blume Mus. Bot. ii, 188; Orchid. Archip. Ind. 139.—*Podanthera pallida* Wight Ic. t. 1795.—*Ceratopsis rosea* Lindl. Gen. & Sp. Orchid. 383.—*Limodorum roseum* Don Prodr. Fl. Nep. 30.

Description : Tuber underground, 5 cm. and more in length; stem 10-40 cm. high; about 1 cm. thick at the base, gradually thinner upwards, with a few bracts and ending in a 5-20 cm. long raceme; flowers drooping, minus the

ovary about 12 mm. long, white; sepals and petals lanceolate-linear, connivent; lip oblong, concave, without side lobes but with a short blunt point, with a few reddish brown spots; spur half as long as the lip, somewhat bulbous; stem and ovary pale ochre-coloured.

Locality: N. Kanara: Yellapur, 1,800 ft. (Bell 4068!).

Flowers: June 1918.

Distribution: Tropical Himalaya, Nepal, Sikkim in hot valleys up to 4,000 ft., Khasia Mts. up to 6,900 ft., N. Kanara, Madras Pres.: Coorg, Bolampatti Hills at 4,500 ft., Anamalais, Pulneys at 5,000 ft., Wynnad, Ceylon, W. Africa, Java, Australia.

31. TROPIDIA Lindl. (not in Cke).

Terrestrial, glabrous, leafy herbs. Stem often branched, roots rigid. Leaves sessile, membranous, subplicate; petiole sheathing. Flowers small, in axillary and terminal sessile or peduncled spikes; bracts coriaceous, often imbricate, strongly nerved. Sepals connivent, lateral more or less connate, dorsal free. Petals as long, or shorter, broad or narrow. Lip superior, sessile at the base of the column, cymbiform or produced into an obtuse spur, undivided, acute or with a reflexed tip, disk with short or long intramarginal ridges on lamellae; column short or long; rostellum long, erect, at length 2-fid; stigma anticous; anther erect, acute or acuminate, cells contiguous; pollinia 2, clavate, 2-cleft, caudicle long or short, gland small. Capsule cylindric-oblong.

Species 12.—Indo-Malayan, Polynesian.

1. *Tropidia Bellii* sp. nov. Blatter & McCann.

[*Pertinens ad sectionem Cnemidiae refert Tropidiam angulosam Blume sed distinguitur foliis basi rotundatis vel in vaginam decurrentibus, minime cordatis bracteis haud dimidiatis florum longitudinem attingentibus, sepalis lateralibus subobtusis sub apice mucronatis, petalis quam sepalum dorsale latioribus, basalibus columnae appendicibus minimis obtusis.*]

Description: Terrestrial, glabrous. Stem about 30 cm. high. Leaves elliptic or broadly lanceolate acuminate, membranous, subplicate, 9-11-nerved, sheathing at base, up to 15 by 7 cm., base rounded or tapering into the sheath. Peduncle short, spike up to 5 cm. long, terminal, about 7-flowered. Bracts about 12 mm. long, linear-subulate, scarcely half as long as the flower. Sepals 3-5-nerved; lateral sepals connate, lanceolate, subobtusate, with a distinct mucro below the tip; dorsal sepal linear-lanceolate, free. Petals broader than dorsal sepal, ovate-lanceolate, 3-5-nerved; lip superior, sessile at base of column, produced into an obtuse spur, undivided, as long as the petals, obtuse, lateral nerves lamellate below middle; basal columnar appendages very small, obtuse. Anther erect, cells contiguous; pollinia 2, clavate; gland minute. Fruit not seen.

Locality: N. Kanara: Guddehalli, in evergreen forest, 1,500 ft., rainfall 150 in. (T. R. Bell 2992! type, Herb. St. X. C. 26562!).

Flowers: Sept. 1917.

32. SPIRANTHES Rich. (Cke. ii, 707).

Terrestrial herbs; roots fibrous or tuberous; stems erect, leafy, or the flowering leafless. Leaves usually narrow. Flowers small, in erect, secund, often twisted, many-flowered spikes. Sepals subequal, free, the lateral gibbous at the base, and inserted obliquely on the ovary, more or less cohering with the similar petals in an erect hood. Lip erect, sessile or clawed, entire or 3-lobed, base concave, disk bearing calli or lamellae. Column short, terete, base often decurrent on the ovary; foot 0. Anther erect, 2-celled; pollinia 2, 2-partite, pendulous.

Species 180-200.—Cosmopolitan with the exception of the arctic and subarctic zones; chiefly in tropical America.

Cooke has 1 species: *S. australis* Lindl. which has to be changed into *S. sinensis* Ames.

Spiranthes sinensis Ames Orchid. II (1908) 53.—*S. australis* Lindl. in Bot. Reg. x (1824) sub t. 823; Dalz. & Gibs. Bomb. Fl. 270; Wight Ic. t. 1724 (media fig. et dextra tantum); King & Pantl. in Ann. Roy. Bot. Gard. Calc. viii (1898) t. 369; Hook. f. F.B.I. vi, 102; Cke. ii, 707.—*Neottia sinensis* Pers. Syn. ii, 511.

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Description: Cke. ii, 707.

Distribution: Konkan, S.M. Country, N. Kanara, throughout India from the Punjab and W. Tibet to Upper Assam and southwards to Ceylon and Chittagong, up to 7,500 ft. in Sikkim and 7,000 ft. in the Nilgiris, Afghanistan, N. Asia, China, Java, Australia, N. Zealand.

33. ZEUXINE Lindl. (Cke. ii. 708).

Species about 35.—Tropical Africa and Asia.

Cooke mentions 2 species from the Bombay Pres.: *Z. sulcata* and *Z. longilabris*. We retain them but change the first name into *Z. strateumatica*.

- | | | | |
|----------------------------|-----|-----|------------------------------|
| 1. Leaves linear, sessile | ... | ... | 1. <i>Z. strateumatica</i> . |
| 2. Leaves ovate, petiolate | ... | ... | 2. <i>Z. longilabris</i> . |

1. *Zeuxine strateumatica* Schlechter in Fedde Repert. Beih i (1911) 77; Fischer Fl. Madras pt. viii (1928) 1456.—*Z. sulcata* Gen. & Sp. Orchid. (1840) 485; Griff. Ic. Pl. Asiat. t. 349; Hook. f. F.B.I. VI, 106 (*excl. Z. membranacea* Lindl.); King Pantl. in Ann. Roy. Bot. Gard. Calc. viii (1893) 286, t. 331; Trim. Fl. Ceyl. iv, 215; Prain Beng. Pl. 1029; Duthie in Ann. Roy. Bot. Gard. Calc. ix, pt. 2, 168; Fl. Upp. Gang. Pl. iii, pt. ii, 219; Cke. II, 708; Haines Bot. Bil. & Or. 1161; Brühl Orchid. Sikkim 171.—*Z. bracteata* Wight Ic. v, pt. 1 (1852) 16, t. 1724 bis.—*Z. brevifolia* Wight Ic. l. c. t. 1725.—*Z. robusta* Wight Ic. t. 1726.—*Pterygodium sulcatum* Roxb. Fl. Ind. iii (1832) 452.

Description: Cke. ii, 708.

Locality: Sind (Stocks 411).—*Gujarat*: Swampy ground on bank of Ambika Nala, Waghai Dangs (T. R. Bell 5386 !).—*Deccan*: Pashan near Poona (Gammie !); Deccan hills (Herb. Econ. Bot. Poona !).—*S.M. Country*: Near the bank of a stream, Gokak Falls, Belgaum Dist. (Sedgwick 5449 !); Dharwar (Law).—*N. Kanara* (Law).

Distribution: Abundant in grassy places throughout the greater portion of India, ascending to about 5,000 ft. on the outer Himalayan ranges, Malay Peninsula, Afghanistan, Ceylon, China, Japan, Java, Philippines.

2. *Zeuxine longilabris* Benth. in Benth. & Hook. f. Gen. Pl. iii (1883) 600; Hook. f. F.B.I. vi, 107; Trim. Fl. Ceyl. IV, 216; Prain Beng. Pl. 1029; Cke. ii, 709; Fischer Fl. Madras pt. viii (1928) 1456.—*Monochilus longilabre* Lindl. Gen. & Sp. Orchid. (1840) 487; Dalz. & Gibs. Bombay Fl. 271.—*M. affine* Wight Ic. v, pt. 1 (1852) 16, t. 1728.

Description: Cke. ii, 709.—Flowers white or olive with lip white and column orange.—The specimen from N. Kanara mentioned below was found epiphytic.

Locality: Konkan (Law, Stocks).—*N. Kanara*: Anmod, on bole of big tree in dense jungle, 2,000 ft. (Sedgwick 3371 !); Anmod (Talbot 1644 !); Pala (Talbot 3530 !).

Distribution: Bengal, Assam, Konkan, N. Kanara, W. Ghats of Madras Pres. from the low country to 4,000 ft., High Wavy Mts., Ceylon.

34. CHEIROSTYLIS GRIFF. (Cke. ii. 709).

Species 15.—Tropical Africa, Indo-Malaya, Australia.

Up to now 1 species was known from the Presidency; we add a new one.

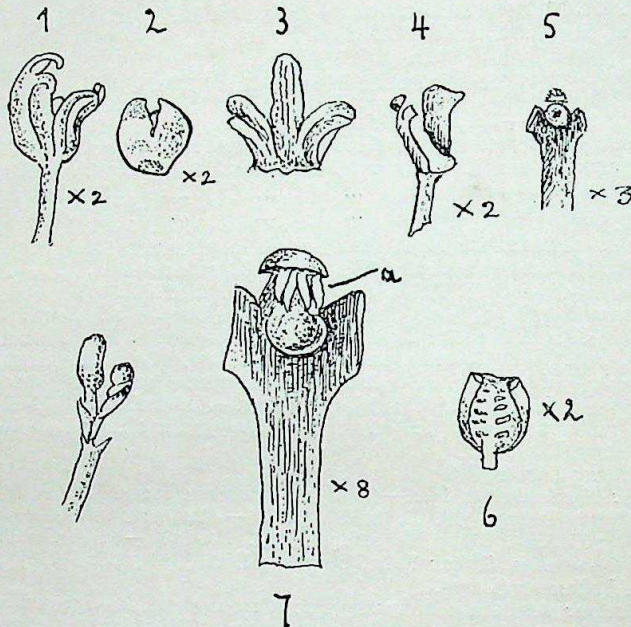
- | | | | |
|---|-----|-----|---------------------------|
| 1. Lip with a spreading suborbicular deeply 2-lobed limb, lobes sub 5-fid | ... | ... | 1. <i>C. flabellata</i> . |
| 2. Lip with 2 large rounded somewhat incurved side lobes; midlobe shorter | ... | ... | 2. <i>C. kanarensis</i> . |

1. *Cheirostylis flabellata* Wight Ic. v, pt. 1 (1852) 16; Dalz. & Gibs. Bomb. Fl. 271; Hook. f. F.B.I. vi, 105; Trim. Fl. Ceyl. iv, 211; Cke. ii, 709; Fisher Fl. Madras pt. viii (1928) 1454.—*Monochilus flabellatum* Wight Ic. t. 1727.

Description: Cke. ii, 709.—The species of *Cheirostylis* are usually terrestrial. T. R. Bell has found an epiphytic specimen at Amboli.

Locality: W. Ghats: Tinai Ghat (Gammie (15816 !); Amboli Ghat (T. R. Bell !)).—S. M. Country: Chorla Ghat (Dalzell & Gibson).—*N. Kanara*: Kumpta-Sirsi road (Woodrow); Guddehalli (T. R. Bell 7842 !).

Distribution: Bhutan Himalaya, Tenasserim, Bombay Pres., Nilgiris and Pulneys at 6,000 ft. and upwards, Ceylon.



Cheirostylis kanarensis Blatter & McCann. *sp. nov.*

1. Flower; 2. Sepals subtending the lip; 3. Dorsal sepal and adnate petals; 4. Lip and Column; 5. Column; 6. Lip. 7a Attachment of pollinia hanging from underside of the raised caps, quite free.

2. *Cheirostylis kanarensis sp. nov.* Blatter & McCann.

Orchidacea similis Ch. flabellatae a qua differt scapo glabro, sepalis lateralibus fere semicircularibus, labio 3-lobato lobis lateralibus magnis.)

Description: A delicate saprophytic plant, only 5-7.5 cm. in height when flowering, extremely fragile, reaching 30 cm. in fruit. Root an irregular-shaped long tuber, lying horizontally about 7 cm. below the surface, 25 by 7 mm. to 7 by 3 mm., sometimes 1, sometimes more tubers to one plant; rootlets given off just below attachment of scape. Bract scarious. Flowers usually 3, racemose, at a right angle to the scape, 10 mm. long, 6 mm. wide between tips of petals when spread out, pure white, light brownish in bud. Pedicels up to 6 mm. long, often, reaching 15 cm. in fruit. Petals and sepals united into an involucre for column and lip, the division between the strongly hooded dorsal part, composed of dorsal sepal and petals and the lower part subtending the lip composed of the 2 sepals, is deepest reaching $\frac{3}{4}$ of the ovary down, the division between the dorsal sepal and petals reaches $\frac{1}{2}$ way down, that between the sepals about $\frac{1}{3}$ of the way; all the divisions are acute. Dorsal sepal linear-oblong and minutely bifid, longest 9 by 2.5 mm.; petals 5 by 2 mm., similar but slightly falcate, entire. Lateral sepals 5 mm. long, nearly semicircular with the junction along the straight edges, edges slightly crenulate, all 3-veined, concave, the veins very prominent on the back, slightly saccate below like *Propax* to allow of the lip-hinges being curved. Lip 5 by 4 mm., with 2 large rounded side lobes, midlobe shorter, shortly rounded; side lobes somewhat incurved. Lip attached to a prolongation of the column by a very delicate curved hinge which allows it to assume the erect position it occupies facing and embracing the column, parallel to the dorsal sepal, with a central yellow, broad, furry ridge which is transversely very irregularly and deeply impressed, not pinnately divided, leaving central axis entire. The column is white,



Del. C. McCann after T. R. Bell.

Cheirostylis kanarensis Blatter and McCann, sp. nov.

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slightly curved forwards and has 2 large square expansions (appendages, nearly parallel to each other, occupying the upper $\frac{1}{4}$ or more, one on each side of the round stigmatic depression; the dorsal part of the column produced very slightly beyond the level of those appendages into a rounded semicircular plate (rostellum) on the apex of which is fixed the cap by its edge, the cap being otherwise free, overhanging the stigmatic depression. To the underside of this cap are hung the 2 bipartite pollinia looking like sausages in a row, all in a line between the appendages of the column. Pollinia greyish, powdery looking, long-ovoid in shape. Ovary slightly twisted at base, 7 mm. long. Fruit large for the flower, being 20 by 4 mm., ovoid in shape but with 1 flattened face, the convex part of circumference having 2 of the 6 longitudinal somewhat predominant ridges (triangular in section), the flattened portion only 1; the apex bears the remains of the withered then cylindrical and brown flower, supported on a basal ring forming the truncated end of fruit. The capsule opens along the apex of the ridges and finally assumes, when completely open, a more or less globose shape, remaining joined at apex and base. The colour of the whole plant in fruit is light straw-yellow except the bracts and flowers which are dark brown. (After detailed sketches and MS. notes of T. R. Bell.)

Note: The tuber or tubers lie about 7 cm. underground in black soil under the shade of trees in jungle generally on the edge of a clearing. The rootlets arise just below the point of attachment of the stem and creep along close to the surface of the ground or on it under decaying leaves. The flowers are fertilized by a small very active hymenopter. The buds are very close together, nearly sessile, but as they get larger, the pedicels gradually lengthen until in flower they reach quite 6 mm. in length. This lengthening of the pedicels continues after flowering and the thickness also increases, until the fruit is ripe, sometimes reaching 15 cm. in length by $1\frac{1}{2}$ times the thickness of the scape, pedicels of different lengths from 5-15 cm. being common on the same plant. The ordinary number of flowers to one plant is 3, but there may be as many as 5 buds, never more than 1 flower developing on any one day; the bloom lasts only a day, expanding in the morning and every 24 hours a fresh flower is produced.

Locality: N. Kanara: Tatwal (T. R. Bell).

Flowers: June 1912.

35. PERISTYLUS Blume. (Cke. ii. 710).

Species about 80.—Warm regions of Old World.

Cooke has 5 species. We retain all and add 1 species, *P. stenostachyus*, not known from the Presidency before, and add a new species: *P. xanthochlorus*.

A. Leaves scattered or imbricate on the stem, not clustered

I. Spur as long as the sepals or longer

1. Stem stout; Leaves many-nerved; spike dense-flowered; spur curved at base ... 1. *P. xanthochlorus*.

2. Stem slender; leaves 5-7-nerved; spike lax-flowered; spur straight ... 2. *P. stenostachyus*.

II. Spur much shorter than the sepals, globose ... 3. *P. spiralis*.

B. Leaves clustered about the middle of the stem

I. Lip longer than the sepals, obtusely 3-fid, lobes linear-oblong ... 4. *P. Stocksii*.

II. Lip shorter than the sepals; petals white ... 5. *P. plantagineus*.

III. Lip as along as the sepals; petals yellow or yellowish green

1. Lateral sepals mucronate at the back below apex; spikes dense, 10-30 cm. long ... 6. *P. goodycroides*.

3. Lateral sepals not mucronate at the back below apex; spikes lax, 5-7.5 cm. long ... 7. *P. Lawii*.

1. *Peristylus xanthochlorus* sp. nov. Blatter & McCann.

Orchidacea similis Peristylu Richardiano Wight necnon *Peristylu stenostachyo* Krzl. *A priore differt scapo minore, foliis apiculatis et multinerviis, bracteis ovato-longe-acuminatis vel ovato-oblongis-acuminatis sepalis lateralibus linearibus falcatis subacutis vel obtusis, petalis ovato-oblongis aliquantulum*

obliquis, labii lobis lateralibus linearibus, in statu sicco tota planta brunnea minime nigrescente. A posteriore autem distinguitur scapo crasso, foliis multinerviis, bracteis multo largioribus floribus viridi-flavis nunquam albidis, spica cylindrica densa multi—(usque 40-) flora, labii lobis lateralibus linearibus obtusis sursum curvatis et retrorsum, calcare ad basin curvato in tertia parte superiore paululum incrassato et ad apicem angustiore.

Description: Tuber one. Stem 12-32 cm. high, stout, stiff, leafy, pale green. Leaves few (4-5), scattered on the stem, pale green or yellowish green, lanceolate or oblong-lanceolate, acute, apiculate, sheathing at base, many-nerved, recurved in the upper part, up to 6 by 2 cm., subplicate, succeeded by 1 or 2 bract-like leaves. Flowers greenish yellow, many (up to 40), subsecund or scattered, never secund, forming a dense terminal cylindrical spike 5-16 cm. long, usually as long as the flowerless part of the scape. Bracts not imbricating, the lower up to 15 by 4-5 mm., shorter or longer than the flowers, ovate-long-acuminate, or ovate-oblong-acuminate, cucullate, upper 7 by 3 mm., midrib prominent on back. Lateral sepals linear, falcate, subacute or obtuse, pale green, 5 by 1.5 mm., obliquely ascending. Dorsal sepal pale green, oblong or narrowly ovate-oblong, obtuse, 5 by 2 mm., 3-nerved. Petals greenish yellow, membranous, ovate-oblong, slightly oblique, obtuse, 5 by 2 mm. Lip fleshy, rigid, 5 mm. long, 10 mm. broad, 3-lobed; basal claw very narrow and short with 2 rounded short auricles; side lobes 5 by 0.75 mm., linear, obtuse, spreading, curved upwards and backwards; midlobe 2.5-3 mm. long, narrowly triangular, obtuse, 1 mm. broad at base, narrower at apex. Ovary sessile, about 8 mm. long. Spur 6-7 mm. long, curved near the base, then appressed to ovary, slightly thickened in the upper third, getting thinner again at apex and obtuse, greenish white. Anther-tubes 0. Stigmatic processes large, elongating, parallel. Pollinia granular; caudicle very slender, as long as the pollinium. Gland very small. Rostellum short. Fruit 10 by 4 mm., sessile, flattened towards the axis, narrowly conical, rounded at base, 6-ridged, slightly twisted.

Locality: *W. Ghats:* Panchgani, 1st Tableland, in low grass (Blatter & Halberg B1686! type, Blatter P81!, Sedgwick 7565! 7596 bis! 7930!); Mahableshwar (Sedgwick 7622 bis! 7642!).

The Panchgani specimens are smaller throughout than those from Mahableshwar. Is it due to the much greater rainfall of the latter place, or to the scanty soil on the Tableland of Panchgani?

Flowers: September 1925 (Panchgani); October 1920 (Panchgani and Mahableshwar).

2. *Peristylus stenostachyus* Kraenzlin Orchid. Gen. & Sp. i, 502; Fischer Fl. Madras pt. viii (1928) 1474.—*Habenaria stenostachya* Benth. Fl. Hongk. 362; Hook. f. F.B.I. vi, 15c.—*H. peristylodes* Wight Ic. t. 1702.—*Platanthera stenostachya* Lindl. in Hook. Journ. Bot. vii (1855) 37.

Description: Plan. 10-50 cm. high, usually slender, with many small sheaths above the leaves. Leaves confined to the lower half or two-thirds of the stem, lanceolate or linear-lanceolate, obtuse, acute or acuminate, 2.5-10 cm. long, 3-17 mm. broad. Spike narrow, 2.5-15 cm. long, lax-flowered; flowers small, about 8 mm. diam., erect, greenish yellow or white; bracts 6-8 mm., broadly ovate-lanceolate, finely acuminate. Sepals 4 mm. long, subequal, concave, lateral linear, obtuse, suberect, at length spreading, nerve very thick, produced into a point under the apex of the sepal. Petals triangular-ovate or oblong, obtuse. Lip excavate at base, side lobes subulate, as long as or slightly longer than the sepals, spreading, longer than the broader, obtuse midlobe. Spur slender, straight, not thickened below. Anther minute, cells parallel, tubes 0. Pollinia short, grains large, caudicle and gland obscure. Stigmatic processes clavate; rostellum erect, truncate, dentate, plicate, concealing the glands of the pollinia. Ovary 6 mm. long.

Locality: *W. Ghats:* Castle Rock, on open rocky ground on the hill side 1,600 ft. (Sedgwick 2779!).—*N. Kanara:* In forests (T. R. Bell 5409!); Mundgod Road, rice fields (Talbot!); Tinai (Talbot 2508!); Yellapur, in abandoned rice fields (Talbot!).

Flowers: August 1917 (Castle Rock); August 1881 (Yellapur); September 1881 (Mundgod Rd.); September 1891 (Tinai).

Distribution: Sikkim Himalaya, Khasia Hills, Tenasserim, N. Kanara, Bababudan and Palney Hills, High Wavy Mountains.

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3. *Peristylus spiralis* A. Rich. in Ann. Sc. Nat. sér. 2, xv, 69, t. 2, B; Wight Ic. t. 1696; Kraenzlin Orchid. Gen. & Sp. i (1898) 510; Cke. ii, 711; Fischer Fl. Madras pt. viii (1928) 1474.—*Habenaria tortu* Hook. f. F.B.I. vi. (1890) 159; Trim. Fl. Ceyl. iv, 234.

Description: Cke. i. c.

Locality: Bombay Pres. (Dalzell 14! in Herb. Calc.).—*Konkan* (Law, Stocks).—*W. Ghats*: Tinai Ghat (Talbot 2508!).

Distribution: Bombay Pres., Bababudan and Nilgiri Hills, 5,000-7,500 ft., Travancore, Ceylon.

4. *Peristylus Stocksii* Kraenzlin Orchid. Gen. & Sp. i (1838) 513; Cke. ii, 710; Fischer Fl. Madras pt. viii (1928) 1475.—*Habenaria Stocksii* Hook. f. F.B.I. vi. (1890) 158.

Description: Cke. i. c.

Locality: *Konkan*: Mulland, in dense forest (McCann!); Dronaghiri (Stocks); Neral (Bhiva!); Ambenali (Blatter & McCann!).—*W. Ghats*: Fitzgerald Ghat, 2 miles from Mahableshwar (McCann 3942!).—*S. M. Country*: Ramghat (Ritchie 1398).—*N. Kanara*: Sirsi, in evergreen forest (Sedgwick & Bell 7004!).

Flowers: July to August (ex Cooke).

Flowers and Fruit: October 1919 and 1930.

Distribution: Bombay Pres., Mysore.

5. *Peristylus plantagineus* Lindl. Gen. & Sp. Orchid. (1835) 300; Wight Ic. t. 921; Kraenzlin Orchid. Gen. & Sp. i (1898) 516; Cke. ii, 711; Fischer Fl. Madras pt. viii. (1928) 1475.—*Peristylus elatus* Dalz. & Gibs. in Kew Journ. Bot. iii (1851) 344; Bomb. Fl. 270.—*Habenaria Wightii* Trim. Cat. Ceyl. Pl. (1885) 91; Hook. f. F.B.I. vi. (1890) 162; Trim. Fl. Ceyl. iv, 232.

Description: Cke. ii, 711.

Locality: *Konkan*: (Nimmo!); Malvan (Dalzell).—*W. Ghats*: Near Lonavla (Kanitkar! Herb. Econ. Bot. Poona); Ramghat (Ritchie 1396); Londa (Sponner!).—*S. M. Country*: Devikot, Dharwar Dist., deciduous forests, 2,000 ft. (Sedgwick 3007!).—*N. Kanara*: Karwar (Talbot!); maritime scrubs on rocks by the sea (Sedgwick & Bell 6783!); Guddehalli (Talbot 443!); on edges of open spaces in jungle (T. R. Bell 7869 bis!); in forests (T. R. Bell 5410!); forests of Nayayali, 2,000 ft., rainfall 80 in. (Sedgwick 2945!); Yellapur, common in places (Talbot 551!).

Flowers: August 1881 (Yellapur); August 1889 (Karwar); August 1883 and 1920 (Guddehalli); September 1883 (Yellapur); September 1919 (Dharwar Dist.); October 1882 (Yellapur).

Fruit: September 1917 (Nayayali) ! October 1919 (Karwar).

Distribution: Central Provinces (Pachmai); Bombay Pres., Madras Pres.: Rampa Hills, Anamalais, 2,000-2,300 ft., Travancore, Malabar, Ceylon.

6. *Peristylus goodyeroides* Lindl. Gen. & Sp. Orchid. (1835) 299; Dalz. & Gibs. Bomb. Fl. 270; Royle Ill. t. 87, f. 2; Cke. II, 712; Fischer Fl. Madras pt. viii (1928) 1475.—*Habenaria goodyeroides* Don Prodr. 25; Hook f. F.B.I. vi, 161; King & Pantl. Ann. Roy. Bot. Gard. viii, t. 430.

Description: Cke. i. c.

Locality: *Konkan* (Nimmo, Dalzell).—*W. Ghats*: Castle Rock, 1,600 ft. (Sedgwick 2806!).—*N. Kanara*: Devimane Ghat (Sedgwick & Bell 6942!).

In bud: August 1917 (Castle Rock).

Distribution: Nepal, Sikkim, Khasia Hills, Naga Hills, *Konkan*, *N. Kanara*, *W. Ghats* of Bombay and Madras Pres., 2,000-4,000 ft.

7. *Peristylus Lawii* Wight Ic. v, pt. 1 (1852) 12, t. 1695; Dalz. & Gibs. Bomb. Fl. 270; Kraenzl. Orchid. Gen. & Sp. i (1898) 510; Cke. II, 712.—*Habenaria Lawii* Hook. f. F.B.I. vi (1890) 162; Prain Beng. Pl. 1032; Duthie in Ann. Roy. Bot. Gard. Calc. ix, pt. 2, 192, t. 143; Fl. Upp. Gang. Pl. iii, pt. ii. (1920) 227.

Description: Cke. ii, 712.

Locality: *Konkan*: (Dalzell, Law); Neral (Bhiva!).—*W. Ghats* (Gibson! Herb. Calc.).—*S. M. Country*: Belgaum (Law); near Dharwar (Law ex Stocks 73).

Distribution: *W. Himalaya*, in Garhwal, Bengal, Bihar, C. Provinces, in the Chanda Dist., Bombay Pres.

36. PLATANThERA Rich. (Cke. ii. 712).

Species about 80.—Throughout the N. temperate regions and in the tropics of Asia and Africa, chiefly in the mountains.

1. *Platanthera Susannæ* Lindl. Gen. & Sp. Orchid. (1835) 295; Dalz. & Gibs. Bomb. Fl. 269; Wight Ic. t. 920; Kraenzl. Orchid. Gen. & Sp. i (1898) 601; Cke. ii, 713; Fischer Fl. Madras pt. viii (1928) 1475.—*Habenaria Susannæ* R. Br. Prodr. (1810) 312; Hook. f. F.B.I. vi (1890) 137; Prain Beng. Pl. 1030; Haines Bot. Bih. & Or. 1155; Duthie in Ann. Roy. Bot. Gard. ix, pt. 2, 178, 128.—*Orchis Susannæ* Linn. Sp. Pl. (1753) 939.—*Orchis gigantea* Don Prodr. 24.—*Platanthera robusta* Lindl. in Wall. Cat. no. 7036.

Description: Cke 1. c.

Locality: *Konkan*: Matheran (Cooke!).—*W. Ghats*: Khandala (Stocks 7, Blatter!, Hallberg!, Cooke!); Panchgani, above Khingar (McCann!); Mahableshwar (Cooke, Blatter & McCann!, McCann!); Castle Rock (Sedgwick 4482!, Gammie 15784!).—*S. M. Country*: Belgaum (Ritchie 1395).—*N. Kanara*: Yellapur (Talbot 732; Herb. Calc., T. R. Bell 3121!).

Distribution: Outer Himalayan range in Garhwal and Kumaon up to 6,000 ft., Sikkim, Khasia, Naga and Manipur Hills, Burma, Chota Nagpur, Konkan, S. M. Country, N. Kanara, W. Ghats of Bombay and Madras Pres., 1,600-7,500 ft., China, Malay Archipelago.

(To be continued.)

THE VERNAY SCIENTIFIC SURVEY OF THE
EASTERN GHATS.
(ORNITHOLOGICAL SECTION).

BY

HUGH WHISTLER, M.B.O.U., ASSISTED BY N. B. KINNAR, M.B.O.U.

PART—II.

(Continued from page 524 of this volume.)

Turdoides somervillei malabaricus (Jerdon).

Specimens collected :—10 ♀ 10-4-29, 25 ♂ 11-4-29, 35 ♂ 12-4-29, 56 ♀ 15-4-29, 130, 135 ♂ 26-4-29 Kurumbapatti; 246 ♂ 18-5-29, 270-271 23-5-29 Shevaroy Hills, 4,000 ft.; 34 ♂ 5-6-29, 343 ♂ 6-6-29, 352 ♀ 7-6-29, 369 ♂ 9-6-29, 381 ♂ 11-6-29, 399 ♂ ? juv. 13-6-29, 406 ♂ juv. 14-6-29 Chitteri range 2,000-3,000 ft.; 572 ♀ 21-7-29 Gingee; 668 ♂ juv. 8-8-29, 681 ♀ 12-8-29, 720 ♂ 20-8-29, 737 ♂ 23-8-29, 738 ♂ juv. 29-8-29 Palkonda Hills, 1,000 ft.; 772-3 ♂ ♀ 30-8-29, 823 ♂ 17-9-29 Koduru; 881 ♂ 5-10-29 Seschachalam Hills, 2,000 ft.; 1,001-2 ♂ ♀ 11-11-29 Nallamalai Hills, 2,000 ft.

Measurements—

	Bill.	Wing.	Tail.	Tarsus.
17 ♂	21-24.5	101-107	100-109	33-36.5 mm.
3 ♂ juv.	21-23	95-99	99-104	33-33.3
7 ♀	20.5-23	94-106	93-104	33.5-35.5 mm.
1 ♀ juv.	22.5	94	88	33 mm.

This is the ordinary race of the Jungle Babbler throughout the greater part of the Madras Presidency. The Survey met with it throughout the various ranges from the Krishna River (Nallamalais, Seschachalam Hills, Palkonda Hills, Shevaroy and Chettiri range) southwards to the Salem District. It occurs up to a height of 4,000 ft., and also apparently in the neighbouring plains, as a shy bird of the better afforested areas. It does not mix with the White-headed Babbler. There is no information as to whether it occurs southwards from Salem to the extremity of the Peninsula, but from the fact that it is common round the base of the Palni Hills and at the foot of the South Travancore Hills we expect that it does so. In the Palnis it occurs up to 4,500 ft. and Ferguson obtained a single bird at 4,000 ft. on the High Range in the North of Travancore but curiously enough it is not recorded from the Nelliampathis. All over the Nilgiris and the Wynad it is common. There is no record from Coorg but it occurs in Malabar.

Turdoides somervillei terricolor (Blyth).

Specimens collected :—1,354 ♂ 8-2-30, 1,399 ♀ 17-2-30 Anantagiri, 3,000 ft.

Measurements—

	Bill.	Wing.	Tail.	Tarsus.
♂	24.5	102.5	95.5	34 mm.
♀	23	96.5	Moult.	33.5 mm.

In the Madras Presidency this race of the common Jungle Babbler is confined to the north-east and even there it is by no means generally distributed.

Jerdon states that it occurs at Gumsoor (B. of I, ii, 59). The above two specimens were procured by La Personne in a silk cotton tree at Anantagiri and he remarks that while it was nowhere common in the Vizagapatam District it was not observed at all at Sankrametta.

Specimens collected by Blanford at Rajamundri, Ellore and Dumagudiam are in the British Museum.

We have seen no evidence for the oft-repeated statement that the Jungle Babbler is double-brooded. All races throughout India appear to breed chiefly during the monsoon rains in June and July though many nests will be found from March to August and odd ones are recorded in the winter months. There may therefore easily be 6 months difference in the age of young birds, hatched in the same generation, which is sufficient to account for the supposed two broods and the apparent coincidence of the moult with the breeding season. Both sexes share in incubation.

In identifying the survey series we have spent a great deal of time studying the difficult question of the races of the Jungle Babbler and in consequence would divide them as follows.

Turdoides somervillei sindianus (Ticehurst).

Crateropus terricolor sindianus Ticehurst, Bull. B.O.C. xl, 1920 (June), p. 156—Karachi, Sindh.

N. W. India. The northern boundary is the Himalayan foothills from the Jumna valley to near Rawalpindi, and the Salt Range. The western boundary lies along the base of the frontier hills from Kohat District to Karachi. The southern boundary is ill defined from lack of specimens but this form occurs at Delhi and Mount Abo. In N. Rajputana it is rare and it is absent from the deserts of Central and Western Rajputana. Not known to occur in Cutch.

Turdoides somervillei terricolor (Blyth).

Malacocercus terricolor Blyth, J.A.S.B., 1844 (after 17th Dec.), p. 367—Nepal.

N.-E. India. The northern boundary is the Himalayan foothills from the Jumna valley to Assam as far east as Dibrugarh. The western boundary is a line drawn roughly through Meerut, Agra, Saugar and S. E. Berar. The eastern and southern boundary is formed by the Brahmaputra River and the coast from the Ganges delta to the Godavary delta.

Turdoides somervillei malabaricus (Jerdon).

Malacocircus malabaricus Jerdon, Ill. Ind. Ornith., text to pl. 19, 1845 (March)—Malabar.

The rest of India, excluding the range of *T. s. somervillei* and the mountains of Southern Travancore.

(NOTE.—All along the junction of the ranges of *sindianus*, *terricolor* and *malabaricus* there is a good deal of intergrading so that individuals cannot be satisfactorily assigned to either race).

Turdoides somervillei somervillei Sykes.

Timalia somervillei Sykes, P.Z.S., 1832 (July 31), p. 88—Bombay ghats.

Confined to a narrow strip of the western coast from about Bombay and Matheran down to the southern part of the Kumta taluka of N. Kanara. In these limits it is found both on the coastal plain and the Sahyadri range above at all heights, but not on the plateau beyond.

The fact that *somervillei* is not a separate species but merely one of the races of the Jungle Babbler has hitherto been obscured by faulty definitions of its distribution. The statement in the *New Fauna* that it occurs from Travancore to Bombay along the west coast is apparently based only on wrong identification of the ferruginous stained specimens of *Turdoides s. polioplocamus*, obtained at Kolachal. In Kanara District it is true that both *somervillei* and *malabaricus* do occur, but whereas the former is confined to the coastal strip down to the southern part of the Kumta taluka and through the Supapetta, the latter bird is confined to the forests above the ghats and does not descend below them (James Davidson, J.B.N.H.S., xi, 655). As *somervillei* is the oldest name it will stand for the species.

At first sight it appears curious that there is no definitive representative of this species in Ceylon. The explanation is that *Turdoides striatus striatus* there really represents both the Jungle and White-headed Babblers and is, strictly speaking, a connecting link between them.

Turdoides striatus polioplocamus Oberholser.

Turdoides striatus polioplocamus Oberholser, Proc. Biol. Soc., Washington, xxxiii, 1920 (Dec.), p. 84—Gingee [= *Crateropus griseus*, Fauna, ed. i.]

Specimens collected:—3 ♀ 9-4-29, 24 ♂ 11-4-29, 34 ♂ 12-4-29, 90 ♂ 19-4-29, 93 ♂, 97 ♀ 20-4-29, 110 ♀ 22-4-29, 131-134 ♂ ♀ ♂ 26-4-29 Kurumbapatti; 307 ♂

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2-6-29, 345 ♂ 6-6-29, 353 ♂ 7-6-29, 356 ♀ 7-6-29 Chitteri range 2,000 ft. ; 457 ♀ 21-6-29 Tirthmalai 1,000 ft. ; 560 ♂ ? 19-7-29 Gingee ; 756 ♀ 26-8-29 Palkonda Hills 530' ; 846 ♀ 28-9-29, 900 ♀ 10-10-29, 903 ♂ 11-10-29, Seschachalam Hills 2,600' ; 954 ♀ 1-11-29, Nallamalai range 2,000 ft.

Measurements—

	Bill.	Wing.	Tail.	Tarsus.
11 ♂	20-22	94.5-109	95-107	32.5-35 mm.
11 ♀	19-21.5	101.5-108	95-106	30.5-35 "

In first year birds the wing and tail measurements are shorter as a rule than in adults, but they are included in the above.

This Babbler has a markedly southern distribution in the Peninsula of India but it is by no means generally distributed. It is the common Babbler of the Madras Presidency and most of its range falls within our limits. On the eastern side, its northern boundary appears to be the Godavery valley where Blanford obtained it 60 miles north of Ellore and as far up as Dumagudiam ; whilst D'Abreu found it still higher at Kotari, south of Chanda. Jerdon's statement that it occurs up to the N. Circars (B. of I, ii, 60) does not include that area itself where elsewhere (Madras Jour. Lit. Sci., 1839, p. 258) he stated he had never seen it.

It is not uncommon at Secunderabad. From here it occurs all down the line of the Eastern ghats (the Nallamalais, Seschachalam, Palkonda, Chettiri Hills) and throughout the Carnatic as far as Salem District. How far it is found south of Salem is unknown to us, but Captain Bates states that it does not occur at all at Trichinopoly. It is, however, common in the extreme south of Travancore about Cape Comorin, extending up the low lying country as far as Anjango.

It is entirely absent from the hill ranges of Travancore and Cochin, the Palnis, the Nilgiris, the Wynaad and Coorg. Although also absent or scarce, so far as is known, in the greater part of Mysore we have seen a specimen from Sivasamodrum (Wardlaw-Ramsay) and it is common round the south-west border as between Muddur and Gandalupet (Davison) and Manzeerabad (Macgregor). From here and Mangalore it extends up the west coast to the Gaprabha River which, on this side, forms its boundary.

There has been a good deal of confusion as to the relationship of the Ceylon Babbler (*Turdoides striatus striatus*) with the two Indian species the Jungle Babbler (*T. somervillei*) and the White-headed Babbler and this has led to statements that the Ceylon bird occurs in Travancore and the Nilgiris.

Now the White-headed Babbler is to be distinguished from the Jungle Babbler by (1) the uniform pale, almost creamy white crown and nape, contrasting with the darker ear-coverts, (2) the smaller and shorter bill, (3) the dark colour and squamation of the chin, throat and breast. In the White-headed Babbler the feathers of these parts are very dark with pale circular fringes, whereas in the Jungle Babbler these feathers are paler with darker streaks down their edges, the differences being most marked on the breast, (4) the richer buff of the abdomen, (5) the pale central streaks on the breast are usually narrower, (6) the general colour of the body plumage is brown as opposed to grey.

In many specimens of the White-headed Babbler, however, the 'White-head' is not very distinct, either from immaturity or wear. In some specimens, indeed, it is hardly paler than in the Jungle Babbler. Such specimens agree closely with the Cinghalese bird as do often immature Jungle Babblers, and to such birds are due the supposed occurrences of *T. s. striatus* in India. The older writers evidently considered *T. s. striatus* as a form of *terricolor* but we entirely agree with Harington and Stuart-Baker in treating it as conspecific with the White-headed Babbler. In our opinion the dark squamated breast is far more important than the pale head as a specific character, whilst intermediates are found in Hume's specimens from Rameswaram Island. These latter are always recorded as *T. s. striatus* but we consider them intermediate in character and definitely closer to the Indian race of the two.

No importance attaches to the ferruginous staining of the specimens in the B. M. from Kolachal, commented on by Hume in S. F., iv, 456. An albino from Madras is recorded in S. F., ix, 507 ; a specimen in the Society's collection from Vellore (J. S. Battie) is largely white, except for the chin, throat and tail.

There is no association in life between the White-headed and Jungle Babblers. Where their distribution coincides it will be found that the White-headed Babbler largely relies on the presence of man to support him against his stronger, more jungle-loving relative.

In this species, as in the last, the breeding season is poorly defined. Eggs may be found in any month but the majority are laid from March to July.

Argya caudata caudata (Dumont).

Cossyphus caudatus Dumont, Dict. Sci. Nat., xxix (1823, December 27), p. 268—India.

Specimen collected :—456. ♀ 21-6-29 Tirthamalai 1,000 ft.

Measurements—

Bill.	Wing.	Tail.	Tarsus.
20	75.5	101	28 mm.

This was apparently the only specimen of the Common Babbler met by the Survey, and the species is clearly far less generally distributed than the sweeping distribution given in the *New Fauna* would lead one to believe.

For the Presidency we can only trace the following records. A specimen obtained by Blanford near Ellore is in the British Museum and a pair from S. Arcot district are in the Indian Museum. Fairbank found it plentiful at the base of the Palai Hills. Although not found in Ceylon it occurs on Rameswaram Island.

In the west of the Presidency it has only been recorded in Coorg (see Betts, J.B.N.H.S., xxxiii, p. 543 who calls it uncommon there, but this record is evidently erroneous and due to confusion with *Argya subrufa*) and at the base of the Coonoor ghat where Hume saw three near the railway station (S. F., vol. x. p. 383).

It is noteworthy that although *Argya caudata* has two subspecies *eclipses* (Trans-Salt Range Plateau) and *huttoni* (Afghanistan, Baluchistan) in those areas where *Argya malcolmi* does not occur, it agrees with that bird in having developed no races in its very wide distribution in India proper.

Argya subrufa (Jerdon).

Timalia subrufa Jerdon, Madras Jour. Lit. Sci. x, 1839 (after October), p. 259—Manantoddy, Wynaad.

Not obtained by the Survey. The distribution given in the *Fauna* is wrong. The Rufous Babbler is found along the Western ghats from Talmet near Mahableshwar (Fairbank) down to Malabar, the Wynaad, Coorg and the Nilgiris, being rare to the north and commoner southwards. It does not ascend to the plateau of the Nilgiris. It is also fairly common throughout the Travancore Hills, though Kinloch does not record it in the Nelliampathis and its occurrence in the Palnis rests on a female in the Indian Museum obtained by W. Daly. Its easterly limits are not very clear but a specimen marked 'Mysore' in the Hume collection and one marked 'Shevaroy's' (W. Daly) in the Indian Museum catalogue suggest that it extends further east than is usually recognised.

The breeding season is given in the *Fauna* as February and March but, although Ferguson obtained a fully fledged young bird at Ponmudi, Travancore, in April (J.B.N.H.S., 202) Davidson in N. Kanara obtained their nests in April and May and also during the rains (J.B.N.H.S., xi., 655).

Argya malcolmi (Sykes).

Timalia malcolmi Sykes, P.Z.S., 1832 (July 31), p. 88—Deccan [= Poona]. Specimens collected :—446 ♂ 449 ♀ 19-6-29 Harur 1,000 ft.; 1069 ♀ 9-12-29 1088-9 ♂ 11-12-29, 1091 O ? 12-12-29, Cumbum Valley.

Measurements—

	Bill.	Wing.	Tail.	Tarsus.
3 ♂	21.5-23	115-20	129-140	35-36.5 mm.
2 ♀	22-23	110.5-118	128	35-36 mm.

The Large Grey Babbler has a somewhat limited distribution in the Presidency where it largely avoids the Eastern ghats, though Roscoe Allen found it breeding at Horsleykonda (J.B.N.H.S., xviii, p. 906). The Survey obtained four specimens in the Cumbum Valley, Kurnool. Jerdon met with it at

Nellore and on the slopes of the Shevaroy. At Harur and Tirthamalai La Personne reports that it was common, though he did not meet with it in other parts of the Salem district.

Further west it is found in the Nilgiris though there also it is local and not common. William Davison and Miss Cockburn found it on the lower slopes below Kotagerry and the former knew of an isolated flock as high as Ootacamund. Terry's record of meeting it once on the lower slopes of the Palnis near Palni village (S.F., x. p. 475) remains the most southerly record.

It is not known to occur on the Western ghats or their seaboard. With this exception, the bird is found northwards over the whole Peninsula to a western boundary through Kathiawar and Rajputana (with possibly an isolated colony in Sindh at Sehwan *vide* Ibis. 1922, p. 541) to the Sutlej at Ferozepore and Ludhiana. The eastern boundary runs from Kurnool through Chanda to Allahabad, but Stuart Baker remarks (*New Fauna* 1, p. 201) that he has received it from Sirguja. This suggests that it is extending its range as Ball had no record of it from Chota Nagpur. The northern boundary between Ludhiana and Allahabad runs along the limit of the plains. In the whole of this wide range it is most common and generally spread on the tablelands of the Deccan. Otherwise it is but locally common, scarce in some localities and missing from others equally suitable. This fact combined with the absence of any races suggests that its present distribution is the result of a rapid spread in comparatively recent times with the increase of cultivation.

The breeding season appears to be the same throughout India, from March to November though the majority of eggs are apparently laid in the rains in June and July. As with other Babblers, however, the season is poorly defined and nests may be found in any month.

Pomatorhinus horsfieldii horsfieldii (Sykes).

Pomatorhinus horsfieldii Sykes, P. Z. S., 1832 (July 31), p. 89,—'Dense woods of the Ghats' [=Mahableshwar].

Specimens Collected:—122 ♂ 24-4-29, 140-142 ♂ 27-4-29 Kurumbapatti; 214 ♂ 218 ♂ 13 5-29, 242 ♀ 17-5-29 Shevaroy Hills 3,500-4,500 ft.; 639-641 ♀ 2-8-29, 669 ♂ 9-8-29, 688 14-8-29 Palkonda Hills 500-1,000 ft.; 991 ♀ 9-11-29 Nallamallai range 2,000 ft., S. Kurnool; 1371-2 ♀ 11-2-30, 1392-3 ♀ 16-2-30, 1760 ♀ 3-5-30 Anantagiri 3,000 ft.; 1478 ♀ 5-3-30, 1544 ♂ 15-3-30, 1603 ♀ 26-3-30 Sankrametta 3000-3500 ft.

Measurements—

	Bill	Wing	Tail	Tarsus
11 ♂	29-33	89-100.5	94-103	31-35 mm.
10 ♀	30-33.5	90-98	91.5-98.5	30.5-34 "

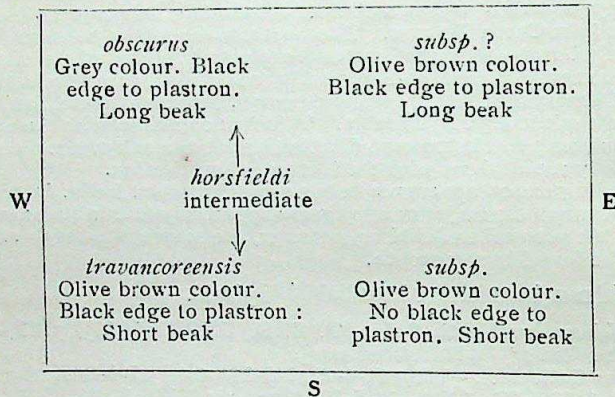
The presence of the Southern Scimitar-Babbler in the Eastern ghats and Orissa has been ignored by the *New Fauna* though the fact was long ago recorded by Jerdon, confirmed by other writers and duly chronicled in the *Old Fauna*. It is as a matter of fact very common and widely spread on the Eastern side of the Presidency.

In the Vizagapatam ghats, La Personne reports that the birds were fairly generally distributed. In early March their organs were slightly enlarged. They fed a great deal on the ground, he says, turning dead leaves over or probing between the thick moss and the bark on trees, and they were also frequent visitors to the flowers of the cotton tree. One was seen to stick its bill into the ground and worry what appeared to be the hole of a trap door spider.

In Cuddapah district they were very common at Ballepalle in August and then had apparently finished breeding, young being on the wing. A bird labelled S. Arcot is in the Indian Museum. In Salem District, according to La Personne, this species was common practically everywhere both in jungle on the plains and up to the highest points of the Shevaroy and Chettivi range. There in May and June the birds were in pairs and their incessant calls could be heard all day long. In the West of the Presidency another race occurs.

We are by no means satisfied that the above series of specimens represents one form. The birds from the Vizagapatam area appear to have a more clearly defined black edge to the white plastron and also larger beaks 31-33.5 mm., as compared with 29-31.5 mm. in the other specimens from south of the Godavery. The correct treatment of the races of this species is a matter of some difficulty. There is no difficulty in recognising a large pale

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The juvenile plumage of this Scimitar Babbler is most interesting. Specimens of both *P. h. horsfieldii* and *P. h. obscurus* are in the British Museum. That of the typical race differs from the adult as follows:—Crown uniform dark olive brown without the black lateral streaks; upper plumage more golden olive brown, especially on the wings and coverts; white feathers of the lower throat with faint black tips; black edging to plastron replaced by bright ferruginous and the remainder of the lower plumage washed and mottled with

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rufous. The juvenile of *obscurus* from Mt. Abou is similar, but reflects the difference of tint in the two races. It will be appreciated, therefore, that the juvenile plumage of Peninsula birds approximates in colour to the adult of the Cinghalese race.

***Pomatorhinus horsfieldii travancoreensis* Harington.**

Pomatorhinus horsfieldii travancoreensis Harington, J. B. N. H. S., xxiii 1914 (Nov. 20), p. 333—Peermall [misprint for Peermade], Travancore.

Although its distribution lies out of the path of the Survey, this form of the Southern Scimitar Babbler is one of the commonest and most widely distributed birds of the Presidency. A specimen from the 'Malabar Coast' is in the British Museum. In Coorg, the Brahmagiris, many parts of the Wynad, the Nilgiris, the Nelliampathis and Palnis and the hills of Travancore it is common and generally distributed at all elevations. A specimen from the High Wavy Mountains (Madura) is in the Society's collection. An albinistic specimen obtained at the Kalhatty Sigur ghat (Nilgiris) 5,500 ft. on 29th June was recorded by Col. H. R. Baker (S. B. N. H. S., xxviii, 1135).

In this area the breeding season appears to be from January until May.

***Dumetia hypertythra hypertythra* (Franklin).**

Timalia hypertythra, Franklin, P. Z. S., 1831 (October 25), p. 118—Between Calcutta and Benares and in the Vindhyan Hills between the latter place and Gurra Mundela.

Specimens collected:—1525 ♀ 12-3-30, 1538-9. ♀♂ 14-3-30, 1592 ♀ 24-3-30, 1653 ♂ 3-4-30, 1654 ♀ 4-4-30 Sankrametta 3,000 ft.—3,500 ft.

Measurements.—

	Bill.	Wing.	Tail.	Tarsus.
2 ♂	14	55-5	62-64-5	18-5-19 mm.
4 ♀	13-14	52-5-55	58-63	18-5-19-5 „

The Survey met with the typical race only in the Vizagapatam District where a series were collected at Sankrametta from 2,000ft. to 3,500ft, and others were observed in the Padwa Valley.

With the exception of Blanford's specimens in the British Museum, obtained 50 miles from Ellore (♀ 11-2-71) and near Rajamundri (♀ 3-4-71) these form the only records for the Presidency.

The Survey has afforded us an opportunity of clearing up the position with regard to the Rufous and White-throated Babblers. These two birds have hitherto been treated as separate species, on the ground that their distributions overlap. We have collated all the published records and examined as many specimens as possible, and have in consequence satisfied ourselves that there is no overlapping of ranges. Certain errors in the early records have been quoted from writer to writer and so obscured the real position.

The typical race is confined to a large area in northern and central India. The most north-westerly locality from which it has been recorded is Koteghar near Simla. This record is based on a single skin in the Hume collection labelled 'Koteghar' without other details to authenticate it and it may be accepted with some reserve, in view of our fairly extensive knowledge of this area. There are however three other skins in the Hume collection taken in 1868 and 1871 in the Kumaon Bhabar.

From the Kumaon Bhabar the species is common locally throughout the central and eastern United Provinces (Lucknow, Cawnpore, Mirzapore, Rae Bareli, Fatehpur and Allahabad (Gill. J.B.N. H. S., xxviii, 1073) to Chunar near Benares) where Brooks found it. There is no record of its being found in Behar and in view of Steven's later testimony we find great difficulty in accepting the authenticity of the skin said to have been collected by Brooks at Darjeeling on 26-5-79. Brooks himself does not refer to this specimen in his Darjeeling notes (S. F., viii). From here the boundary runs down through Orissa where Ball (S. F., vii. 213) records it at Maunbhum and Midnapore, as well as in other districts south of that line.

From Lucknow and Cawnpore the north-eastern limits of the typical race appear to run roughly through the line Jhansi, Sebare and Mhow to Seoni in the Satpuras, that is along the shore of the ancient Indian continent. From the Satpuras the boundary line runs roughly across to Hyderabad city and the valley of the Krishna, which at this point is clearly the southern limit of the

typical race. Throughout its range the distribution is somewhat patchy but it occurs alike in the hills and plains.

The fact that the distribution of the Rufous Babbler is generally given as extending to the Konkan and Thana and Khandalla is due to early records quoted by Barnes (and in more detail by Hume) on the authority of Mr. Wenden. There is plenty of evidence, however, that *albogularis* is the form in these localities and even Jerdon himself did not at one time discriminate satisfactorily between the buff-throated and white-throated races.

The breeding season in this race is well defined throughout its range, being in the monsoon from June to August, the majority of eggs being laid in July.

The white-throated race *albogularis*, on the other hand is confined to a strip of country down western India and to the south of the Peninsula. A single specimen from Sambhur 1869 is in the Hume collection but in this neighbourhood the bird must be very rare as it does not occur in Adam's original Sambhur list. It is however not uncommon at Mt. Aboo and Deesa and from there extends through Baroda, Western Khandesh (Dhulia, Nundurbar, Khondabhari ghat), Nasik and the whole range of the Sahyadris (Khandalla, Mahabaleshwar) with their adjoining districts. Fairbank is careful to emphasise that in this area it is very definitely a bird of the ghats and does not extend over into the Deccan (S. F., iv. 258). In the South Konkan and Kanara it is scarce, though it is apparently commoner again in Mysore. Here we are directly opposite to the southernmost limit of the typical race in the valley of the Krishna and south of this line it suffices to say here (for details will be found in the proper place) that *albogularis* is widely distributed, though not universally, in the rest of the Peninsula and Ceylon.

Dumetia hyperythra albogularis (Blyth).

Malacocercus (?) *albogularis* Blyth, J.A.S.B., xvi, 1847, (after May), p. 453—Taipoor Pass and near Jaulnah.

Specimens collected—37-39 ♂♂ 13-4-29, 49 ♂ 14-4-29, 107 ♀ 22-4-29, 137-8 ♂♂ 27-4-29, 156 ♂ 30-4-29 Kurumbapatti; 254 ♀ 20-5-29, 256 ♂ 21-5-29 Shevaroy Hills 4,800 ft., 327 ♂ 5-6-29, 408 ♂ 14-6-29 Chettiri range 2,000-3,000 ft.; 539 ♀ 544-5, ♂ ♀ 17-7-29 Gingee; 648-9 ♀ ♂ 4-8-29, 671 ♀ 9-8-29, 684 ♀ 13-8-29, 691 ♂ 14-8-29, 692 ♂ 15-8-29, 724 ♀ 21-8-29, 731 ♀ 22-8-29, 742-3 ♂♂ 24-8-29 Palkonda Hills 1,000 ft.; 774-5 ♂♂ 31-8-29, 826 ♀ 18-9-29, Koduru; 933-4 ♂♂ 20-10-29 Seshachalam Hills 2,000 ft.; 999 ♀ 11-11-29, 1033-4 (♀♂) 25-11-29 Nallamalai range 2,000 ft.

Measurements (excluding the intermediate Nallamalai birds)—

	Bill.	Wing.	Tail.	Tarsus.
21 ♂	13-14.5	53-61.5	59-69	18.5-20.5 mm.
10 ♀	12.5-14	54-58	59.5-69	17-19 5 mm.

D.h. albogularis differs from the typical race in being rather lighter and brighter in tint of colouration, in having a well-defined white patch on the chin and throat and the centre of the abdomen more or less white.

No significance attaches to the presence or absence of black shafts to the feathers of the white gular patch or pale shafts to the feathers of the forehead, except that the former are not found at all in the typical race.

Harington separated birds from Mt. Aboo, Deesa and the west coast down to Mahabaleshwar as *D.h. abuensis* (J.B.N.H.S., xxiii, 1915, 429—Mt. Aboo) as having the rufous of the forehead deeper and more extensive and the under parts darker. This we do not accept. The latter character certainly does not hold while the former appears to be a matter of individual variation. It is noteworthy that the Sambhur specimen agrees in every respect with topotypes or even Ceylon birds. Two juveniles from Mt. Aboo are quite indistinguishable from the juvenile of the typical form.

The Survey found the White-throated Babbler a very common bird. In Salem district it was common everywhere both in the plains, forests or wherever there were hedges or sparse jungle to provide the necessary cover. On the Shevaroy and Chitteri range they were found up to 4,000 ft. At Gingee in South Arcot, at Bal'epalle Gulvalacheruv and the Palkonda Hills (1,000 ft.) and Koduru in South Cuddapah and in the Seshachalam Hills (2,000 ft.) it was equally common. It was recorded at Horsley Konda by Roscoe Allen (J.B.N.H.S. xviii, 907). In the Nallamallai range (2,000 ft.) of S. Kurnool it was also common and the specimens from the last locality show definite intergradation with the typical race whose range starts between the Krishna and Godavary rivers,

As to the distribution of the White-throated Babbler in the rest of the Presidency it is known to occur in the Palnis, it is common from 1,000 ft. to 3,000 ft. in the hills of Travancore, William Davison shot it at Neddivatum 6,500 ft. and Col. H. R. Baker at Segore 4,000 ft. in the Nilgiris and the former found it in many places in the Wynaad.

The breeding season is apparently not so well defined as in the typical race, but varies from the middle of April to the middle of October, irrespective of locality.

Chrysomma sinensis sinensis (Gmelin).

Parus sinensis Gmelin, Syst. Nat. vol. i, Part ii (1789), p. 1012—China.

Specimens collected:—64 ♂ 16-4-29, 106 ♂ 22-4-29, 148 28-4-29, 193 4 ♂ 6-5-29, Kurumbapatti; 656 ♂ 6-8-29, 718 ♂ 20 8-29, 739 ♂ 24-8-29 Palkonda Hills 1,000 ft.; 804 ♂ 11-9-29 Kodur 500 ft.; 932 ♂ 20-10-29 Seshachalam Hills 2,000 ft.; 1473 ♀ 4-3-30, 1493 ♀ 7-3-30, 1520 ♀ 11 3-30, 1552 ♀ 16-3-30, 1574 ♀ 20-3-30, 1625-6 ♂ ♀ 30-3-30, 1655 ♀ 4-4-30, 1678 ♂ 12-4-30 Sankrametta 3,000-3,500 ft.

Measurements—

	Bill.	Wing.	Tail.	Tarsus.
11 ♂	13·5-14·5	64·5-70	73·5-92·5	24-26 5 mm.
7 ♀	13·5-14·5	63-69	79-89·5	25-27 mm.

The Yellow-eyed Babbler must be very generally distributed in the Presidency though there are very few details about it actually on record.

La Personne reports that it was quite common on the sparsely covered hillsides about Sankrametta, keeping in March and April in little parties of five and six. In Cuddapah district (August to October) it was only seen in bushy country outside the forest, where the birds were in pairs and very shy and wild, evidently breeding. It was not noted in the Shevaroy's or the plains below the Chitteri hills but about Kurumbapatti it was found in small numbers in hedges and sparse jungle.

On the west it seems to be much less common, doubtless because of the humidity of that side. Hume thought he had seen a specimen from the Wynaad (S.F., x. 373) and it certainly occurs in the Nilgiris as William Davison shot a specimen about 6 miles from Ootacamund and Miss Cockburn knew of it breeding at Kotagerry. Jerdon found it at Wulliar and also near the base of the Shandee Mungalum hills (wherever they may be).

Throughout its range in India the Yellow-eyed Babbler breeds during the rains. Eggs may be found from May to October but the vast majority will be found from the end of July to the beginning of September. The post-nuptial moult is therefore very late, and there is a correspondingly late partial spring moult. This fact is of importance as it has obscured the change of length of tail in summer and winter plumage, which the Yellow-eyed Babbler shares with other birds of similar facies, e.g. *Prinia* and *Suya*. The central pair of tail feathers are moulted in spring and the summer pair are shorter than the winter pair.

In our first report (J.B.N.H.S., xxxiv, p. 393) we mentioned that Ticehurst and Stuart Baker differed in their treatment of this species but the difference has since been removed by Stuart Baker's later agreement (*New Fauna*, viii, p. 44) in Ticehurst's recognition of a pale race *hypoleucus* of Franklin in the dry north-west. Both agree that the birds of the rest of India agree with the typical form. We do not quite understand what Mr. Stuart Baker considers the type locality for *sinensis*. In vol. I, p. 233 he gives Sina=China, but in vol. viii, p. 45 he says that China is an error, without however specifying any other locality. As a matter of fact there is no difficulty in accepting China as the type locality. Latham (on whose description Gmelin's name is based) says that he described the bird from drawings in the possession of Captain Broadley and that the bird came from China. The species certainly occurs in S.-W. China, e.g. Kwangtung, Kwangi and Yunnan (La Touche, *Birds of E. China*, pt. i, p. 72).

We cannot however satisfy ourselves that the bird of the Eastern ghats and India generally, exclusive of the range of *hypoleucus*, is the same as the Chinese bird. There are only two Chinese specimens (Vaughan) in the British Museum and of these the male (March) has a tail of 105 mms. La Touche separated the Yunnan birds as *Pycnorhis s. major* on the ground of size, but unfortunately he compares them with our Indian bird and not topotypes. We

suspect that Yunnan and Chinese birds will prove to be definitely larger than South Indian specimens of which the great majority have tails below 90 mm. Until however we are able to examine a reliably sexed series from China we are unable to settle the point. Allowance will also have to be made for the seasonal change in length of tail. For the moment therefore we are compelled to accept the usual identification of these southern birds as belonging to the typical form.

Pellorneum ruficeps ruficeps, Swainson.

Pellorneum ruficeps Swainson, Fauna Borealis. Amer. 1832 (Febr.) p. 487—India.

Specimens collected:—86 ♀ 19-4-29, 118-9 ♀♂ 24-4-29, 183-4 ♀♂ 4-5-29 Kurumbapatti; 215 ♂ 13-5-29, 224 ♂ 15-5-29, 243 ♀ 17-5-29, 275 ♀ 23-5-29 Shevaroy Hills 3,500 ft.; 305 ♂ 2-6-29, 328 ♂ 5-6-29, 386-7 ♂♂ 8-6-29, 394 juv. 12-6-29, 420 ♂ 15-6-29 Chitteri range 2,000 ft.; 630, 6-3, 635 ♂♂ 1-8-29, 650 ♂ 4-8-29, 672 ♂ 10-8-29, 697 ♂ 16-8-29, 711 ♀ 19-8-29, 745 ♀ 24-8-29, 747 ♂ 25-8-29 Palkonda Hills 1,000 ft.; 1339-40 ♂♀ 6-2-30, 1347 ♀ 7-2-30, 1405 ♀ 18-2-30, 1409 ♂ 19-2-30, 1485 ♀ 6-3-30, 1768 ♂ 4-5-30 Anantagiri 3,000 ft.; 1,481 ♂ 6-3-30, 1609 ♀ 26-3-30, 1617 ♂ 28-3-30 Sankrametta 3,000-3,500 ft.; 1,714a ♂ 21-4-30, 1724 ♀ 24-4-30 Jeypore Agency.

Measurements—

	Bill.	Wing.	Tail.	Tarsus.
22 ♂	17-20	68-5-77	61-5-70	25-28 mm.
14 ♀	16-5-19-5	66-73-5	57-5-69	25-27-5 mm.

This is another species of which the Indian distribution is far from properly known. It occurs in the whole of the ranges of Western India from Nandarbar in Khandesh down to the hills of Travancore. It is fairly common in Pachmarhi (Osmaston, J.B.N.H.S., xxviii, 454) and Thompson obtained it in Mundla District in the centre of the Peninsula; while on the east side it is found in the Rajmehar Hills (Ball, S.F., ii, 409), on Parisnath Hill (Brooks), in a patch of country about Maunbhum and Dholbhum (Tickell and Beavan) whilst La Personne found it common and widely spread in the hills of the Vizagapatam District about 3,000-3,500 ft. South of this area, it is not recorded again until we come to Horsleykonda (Roscoe Allen, J.B.N.H.S., xviii, 905) and the Palkonda Hills where La Personne found it common at 1,000-2,000 ft. In Salem District it appears to be common at all heights up to 4,500 ft. wherever thickets supply the necessary cover and from here in addition to La Personne's notes and specimens from Kurumbapatti, Shevaroy and Chitteri range, there are specimens in the Indian Museum collected by Daly in the Shevaroy and Beadnell's notes on the breeding of the bird at Yercaud (J.B.N.H.S., xxix, 292). Whether it occurs on the tableland of the Deccan proper is unknown.

It is not uncommon in the Nilgiris, the Wynad and the Brahmagiris and in Coorg.

Throughout the wide range outlined above, except in the areas mentioned under *P. r. granti*, the bird remains remarkably constant in size and colouration though in the north-east about Orissa there is a tendency for the colouration to grow slightly richer in tint but not sufficiently to warrant the separation of a subspecies.

The breeding season is regular throughout India from March to June, earlier in these limits in the east and south and later in them in Pachmarhi and the Bombay Presidency.

Pellorneum ruficeps granti, Harington.

Pellorneum ruficeps granti Harington, Bull. B.O.C., xxxiii, 1913 (Dec. 10), p. 81.—Mynall, Travancore.

This very richly coloured race is rare in collections and it appears also to be rare in life in Travancore. Bourdillon (S.F., iv, 399) says that he only procured one at 2,500 ft and Ferguson (J.B.N.H.S., xv, 258) says that he only met two in January 1901 on the Cardamum Hills at 3,000 ft. A spotted Babbler said to be common in the Nelliampathis (Kinloch, J.B.N.H.S., xvii, 940) and in the Palnis (Fairbank, S.F., v, 404) is presumably also of this race but no specimens exist. The same applies to the records for Palmaner, Chittoor District (Hasted) and Trichur (Jerdon).

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Stuart Baker (*New Fauna*, vol. i, p. 240) extends the range of this race to the Wynnad, Coorg and S.-W. Mysore thereby cutting off the typical race in the Nilgiris from the rest of its habitat on the Western ghats proper. With this we are unable to agree. The most that can be said is that some specimens from the low jungles of Malabar, Coorg and the Wynnad are intermediate, showing the intergrading of the two races. Birds from Mysore and the Nilgiris certainly belong to the typical race.

The breeding season is not recorded.

Stachyridopsis rufifrons ambigua Harington.

Stachyridopsis rufifrons ambigua Harington, J.B.N.H.S., xxiii, 1915 (May), p. 631—Gunjong, N. Cachar.

Specimens collected :—1504 ♀ 9-3-30, 1595-97 ♂ ♀ 24-3-30 Sankrametta 3500 ft.

Measurements—

	Bill.	Wing.	Tail.	Tarsus.
♂	15	55.5	53	19.5 mm.
2 ♀	14	53	48.5-51	...

The above specimens represent the only record of the Red-fronted Babbler in Peninsula India. La Personne's note is as follows :—Not quite so common as *mitornis* and appears to inhabit higher altitudes; specimens were secured at 3,500 ft.-4,000 ft., always in thick forest in ravines. In habits they at times resemble the fly-catchers, often catching their food on the wing. Extremely shy birds. They do not move about in parties at this season (March-April).

Mixornis gularis rubricapilla (Tickell).

Molacilla rubicapilla Tickell, J.A.S.B., ii, 1833 (after November), p. 576—Borabhum, in Manbhum.

Specimens collected :—1606 ♀ 26-3-30, 1618 ♂ 28-3-30, 1642 ♀ 2-4-30, 1662 ♂ 4-4-30 Sankrametta 3,000 ft.; 1736 ♂ 27-4-30 Jeypore Agency 3,000 ft.; 1766 ♀ 5-5-30 Anantagiri 3,000'.

Measurements :—

	Bill.	Wing.	Tail.	Tarsus.
3 ♂	15	59-62	53-57.5	18-18.5 mm.
3 ♀	14.5-15.5	57-59.5	50.5-55	18.5-19 "

Previously unknown to occur in the Madras Presidency. Met with by the Survey only within the Vizagapatam District. La Personne's note is as follows :—I found it quite common at Sankrametta 3,000 ft. where it was breeding. Towards the latter end of April these birds were observed nest-building, the material being taken from a fish-tail palm. The birds take hold of a strand from the palm and then appear to drop earthwards, the weight of their bodies stripping the strand from the outer-coverings of the palm. They move about in small parties keeping well under cover and are quite undistinguishable from *Dumetia* in their habits and movements.

The Yellow-breasted Babbler might have been expected to occur in Vizagapatam; for it was first found in Borabhum and Dholbhum by Tickell and later by Beaven on the banks of the R. Cossye. Chota Nagpore was included in consequence in the distribution in the *Old Fauna* though omitted again in the *New Fauna* (in spite of the fact that the type locality falls within the area). Whilst further to the south-west it was discovered at Parasgaon in Bastar State by D'Abreu (J.B.N.H.S., xxiii, 154).

Alcippe poioicephala poioicephala (Jerdon).

Thimalia poioicephala Jerd., Madr. Jour. Lit. Sci., xiii, 1844 (after April), p. 169—Coonour ghat, Nilgiris.

The range of this race of the Quaker-Babbler lies to the west of the area covered by the Survey. It is fairly common in the Travancore Hills at 2,000 ft. and upwards and is perhaps most numerous in the High Range. It is also common in the Palnis but has not been recorded from the other ranges of this group. In the Nilgiris it is exceedingly common up to 6,000 ft. and thence it extends into the Wynnad and Brahmagiris. Birds from the areas round about Goa are intermediate in character.

The breeding season is from January to June. At Culpatty, S. Wynaad, Mr. Darling, Junr., found a nest as late as October.

Alcippe poioicephala brucei Hume.

Alcippe brucei Hume, J. A. S. B., xxxix 1870 (June 7), p. 122—Mahableshwar. Specimens collected:—200-1 ♂ 11-5-29, 211-12 ♀♀ 12-5-29, 226 ♀ 15-5-29, 247 ♀ 18-5-29 Shevaroy's 3,500 ft.; 428 ♀ 16-6-29, Chitteri Hills 3,000 ft.; 1345-6 ♀♀ 7-2-30, 1356 59 ♂ 9-2-30, 1362-65 ♀♀ 10-2-30, 1775 ♂ 5-5-30 Anantagiri 3,000 ft.; 1469 ♀ 4-3-30, 1475 ♀ 5-3-30, 1512-3 ♀♀ 10-3-30, 1519 ♀ 11-3-30, 1526 ♂ 12-3-30 1532 ♀ 13-3-30, 1557 ♀ 17-3-30, 1569 ♂ 19-3-30, 1594 ♀ 24-3-30, 1622 ♂ 28-3-30, 1648 ♀ 3-4-30, 1675 ♂ 12-4-30 Sankrametta 3,500 ft.—3,800 ft.; 1713 ♂ 21-4-30, 1735 ♀ 27-4-30, 1750 ♀ 30-4-30 Jeypore Agency 3,000 ft.

Measurements—

	Bill.	Wing.	Tail.	Tarsus.
12 ♂	15-17	69·5-77	64·5-70·5	21-24 mm.
18 ♀	15-16·5	67-74	61·5-70·5	21-23 „

This race of Quaker-Babbler, not previously known to occur within the Presidency, was found by La Personne in considerable numbers in the Shevaroy's and Chitteri ranges about 3,000 ft.—4,000 ft. and again on the summits of the hills in the Vizagapatam District at about 2,500 ft. to 5,000 ft. In the latter direction the bird must be fairly widely spread as D'Abreu (Jour. B.N.H.S., xxiii, 154.) procured a specimen on January 22, at Parasgaon in Bastar State and Walton procured it at Kutri, Daspalla, Orissa on February 4, 1902.

We cannot separate these birds in any way from those of the Western ghats where the species occurs from the Goa frontier to W. Khandesh and Rajkote in Kathiawar; whilst Hume's specimen in the B. M. from Parasnath Hill, D'Abreu's statement that it is in common in the Baihar Tehsil of the Balaghat District and the fact that the bird is not uncommon at Pachmarhi (B.B. Osmaston, J.B.N.H.S., xxviii, 454) suggest that the distribution is wider than is at present known.

At Pachmarhi it breeds early in July according to Osmaston and eggs were found in Khandesh on August 16.

Rhopocichla atriceps atriceps (Jerdon).

Brachypteryx atriceps Jerdon, Madr. Jour. Lit. Sci., vol. x, 1839 (October), p. 250—Trichoor.

Rhopocichla atriceps bourdilloni (Hume).

Alcippe bourdilloni Hume, S. F., iv (1876 December), p. 485—Mynall, Travancore.

Not met by the Survey.

The Black-headed Babbler is very common in Coorg and the Wyhaad, in the Nilgiris up to about 5,500 ft., and in smaller numbers beyond our limits into some part of Mysore and along the Western ghats at least as far as the neighbourhood of Belgaum. Southwards there is some doubt as to its exact distribution. There is a specimen in the British Museum from the Palghat Hills, and in the Nelliampathy Hills, according to Kinloch, it is very common. The type locality Trichoor in Cochín State is close to the Nelliampathies.

South of this again throughout the hill ranges of Travancore and in the High Wavy Mountains of Madura (where a specimen was collected by Mr. Prater) it is said to be replaced by a different race *R. a. bourdilloni*. This differs in having the black cap replaced by brown and the under parts ferruginous.

We are by no means certain that this supposed race is not merely founded on the juvenile plumage. If not it is curious that the division between the races should occur on the Cochín-Travancore border and not at the Palghat Gap. Whilst Ferguson's statement (J.B.N.H.S., xv, 260) that both forms occur throughout the Travancore Hills, though *atriceps* is far less common, in any case should prevent their being treated as geographical races, if different.

Unfortunately the series in the British Museum does not settle the point. The characters by which one can generally recognise the young of Timaline birds—a blunt broad first primary and 'decomposed' feathers, particularly in the under tail coverts—are found in both black-headed and brown-headed specimens. Until therefore the question has been settled by careful observation and dissection in the field we do not like to upset the accepted division,

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based on the fact that all specimens in the British Museum with black heads come from the north of the range and all with brown heads from the south.

The Ceylon race *R. a. nigrifrons* is of course quite distinct.

Nests may be found practically throughout the year but the main breeding season seems to be from March to July. The bird is semi-colonial in its breeding habits.

Ægithina tiphia humei Stuart-Baker.

Specimens collected:—18-19 ♂ Imm. ♀ 11-4-29, 42 ♀ 13-4-29, 77 ♀ 18-4-296 99-101 ♂♂ 21-4-29, 189-190 ♂♂ 5-5-29 Kurumbapatti; 287 ♂ 29-5-29, 314-1, ♂♂ 322 ♂ 3-6-29, Chitteri range 2,000 ft.; 440 ♂ 18-6-29 Harui 1,000 ft.; 490 ♂ Imm. 3-7-29, 508 ♀ 4-7-29, 523 ♂ 6-7-29 Kalai; 541-2 ♀♂ 17-7-29, 546 ♂ 18-7-29, 568 ♂ 20-7-29 Gingee; 634 ♂ 1-8-29, 647 [♂] 4-8-29, 685 13-8-29, 689 ♂ 14-8-29, 709 ♀ juv. 29-8-29, 712 ♀ 19-8-29 Palkonda Hills 500-1000 ft.; 786 ♀ 2-9-29 Kodur 500 ft.; 853 ♂ 30-9-29, 856 ♀ 1-10-29, 919 ♀ 14-10-29 Seshachalam Hills 2,000 ft. 948 ♀ 31-10-29, 993 [♂] 9-11-29 Nallamallai Range 2,000 ft.; 1107 ♂ 14-12-29, 1134 ♂ 18-12-29 Cumbum Valley; 1321 ♂ 5-2-30, 1330 ♀ 6-2-30, 1432 ♀ 23-2-30, 1754 ♂ 2-5-30 Anantagiri 3,000 ft.; 1565 ♂ 19-3-30, 1663 ♂ 5-4-30, 1674 ♂ Imm. 12-4-30 Sankrametta 3,050-3,500 ft.; 1737 ♂ 28-4-30 Jeypore Agency 3,000 ft.

Measurements—

	Bill.	Wing.	Tail.	Tarsus.
27 ♂	16-19	61-69	44-51	18-20 mm.
3 ♂ Imm.	17-5-18-5	61-64	48-53	18-5-20 "
14 ♀	16-18-5	62-67	46-5-54	18-20 "

The Iora is found practically throughout India except in those dry areas west of a line drawn, roughly speaking, from the head of the Gulf of Cambay through Mt. Abou to Kangra. In the Madras Presidency it is apparently common throughout the whole of the plains and all but the highest peaks of the various ghat ranges of the eastern side upto about 4,000 ft. In the south-west it seems to be more definitely a bird of the plains as it avoids the Palni Hills and the Travancore ranges south of the Palghat Gap. North of that gap it is again found in the hills and is common in the lower slopes of the Nilgiris, upto 3,000 ft. and in the Wynad and Coorg.

The identification of the huge series obtained by the Survey has only confirmed the accuracy of Hume's most able exposition in *Stray Feathers* (S. F., v. pp. 434-41) of the facts regarding the variation of this bird throughout India, except that with an additional number of specimens available for examination we find that his supposed race in the Central Provinces is not as clearly defined as he thought. The facts are not in dispute. It only remains to express them in terms of subspecies and trinomial nomenclature, and we find ourselves unable to agree with the arrangement accepted in the *New Fauna*.

The study of this species is exceedingly difficult and nothing can be accomplished unless the general principles underlying the variations in plumage are clearly understood in advance.

The juvenile plumage is, roughly speaking, similar to that of the female. After the post-juvénal moult the sexes are alike and cannot be distinguished from the adult female, which is alike in summer and winter plumage and lacks any black on the body plumage or tail and has the black of the wing coverts and quills much duller and grayer. Whether the young male normally breeds in this female plumage is not very clear. Hume says (S. F., v. 430) that it assumes the black tail in March and April but sometimes at any rate it breeds in the female plumage and assumes the black tail and wings at the post-nuptial moult about July. After the second autumn it certainly is not distinguishable from the adult and then always has the black tail.¹

The adult male has a distinctive summer and winter plumage, the former being assumed by a partial spring moult. The summer plumage in Ceylon consists of the upper parts being deep almost unbroken black, except for the yellow rump, and the under parts are bright canary yellow. In extreme north-western India on the other hand the upper parts in summer plumage are green

¹ The tail is black in the adult male, summer and winter of *Æ. t. humei* in spite of the statement to the contrary in the *New Fauna*, vol. i., p. 343.

as in winter. In some specimens there is an occasional black feather or a faint mottling with black on the upper parts. The lower parts are only slightly brighter than in winter plumage. The summer plumage of the north, in other words, agrees with the winter plumage of the south.

In winter plumage in Ceylon (and perhaps south-west India) there is a certain amount of black on the upper plumage and this is never found in winter plumage in the extreme north.

Between the extremes as thus outlined there is a very gradual and general transition throughout the Peninsula, only interrupted by individual variation and an east to west intergradation in the centre of the Peninsula with *Egithina nigrolutea*. The main breeding season is in the rains from June to August but nests may be found from March to October. The result is rather prolonged and irregular moulting dates which tend to obscure the recognition of breeding and non-breeding plumages.

The position of Marshall's Iora (*E. nigrolutea*) is very hard to understand. In appearance and plumage stages it would seem to be merely another subspecies of the Common Iora. The striking contrast between the black crown and golden collar, the black tail of all known plumages (the juvenile plumage is unknown), the amount of white on the wings and tail are merely the perfection of features which are present in the races of *tiphia*. On the east it evidently intergrades with *tiphia* for the variety mentioned by Hume on p. 439 of his exposition and crystallised by Mr. Baker as his race *humei* is nothing more or less than an intermediate between the two species. Yet on the west *nigrolutea* extends as a solid wedge between the green-backed bird of the north-west and the black and yellow backed birds of southern India generally, neither intergrading with them nor allowing intergradation between them. Its range embraces Cutch, Guzerat, Western Khandesh, Eastern Rajputana, the south-east Punjab and the south-west United Provinces, extending eastwards to an extent not satisfactorily verified but apparently to Chota Nagpur (Hazaribagh and Lohardugga). This range is largely complementary to that of the forms of *tiphia* but in one or two areas, e. g. western Khandesh (S. F., x. 306) there seems little or no doubt that *nigrolutea* and *tiphia* subsp. are found and breed in the same area. It seems almost as if *nigrolutea* was really a subspecies of *tiphia* which towards its western limits has reached the status of a full species and as such is able in turn to invade the distribution of another subspecies of the parent form. Possibly however, once attention is directed to the problem, further observation will establish that the overlapping is not so wide as the incomplete data available appears to suggest, and that *nigrolutea* will finally be accepted as a race of *tiphia*. At present however we are hardly justified in drawing this conclusion and do not do so.

Mr. Baker's arrangement is this. Ceylon and South Travancore are assigned to *E. t. multicolor*. The whole of the rest of the range in India is assigned to *E. t. tiphia*, as well as Assam, Burma, the north of the Malay Peninsula, western Siam and Annam. Out of that immense range, south central India is reserved for *E. t. humei* the intermediate.

There is an unsatisfactory want of proportion about this arrangement. It separates the birds of north and south Travancore,—both of which are black above in breeding plumage,—on a difference of tint which is certainly hard to appreciate if it exists at all. It unites the bird of north Travancore, where the black-backed summer and green-backed winter plumages are absolutely different, with the bird of the extreme north-west where summer and winter there is no change in the green backed plumage. Yet accepting these marked differences as negligible it singles out a section of the intermediate chain between them, at the point where there is also intergradation with *nigrolutea*, and separates it as a valid race. Surely thus the part becomes greater than the whole.

The explanation is of course that Mr. Baker has merely accepted the distinctions enumerated by Hume at their face value and given a name and a subspecific value to them. One has only to examine extra material to realise that the differences given by Hume are neither constant nor confined to that particular area. The golden collar of the male can be traced far further south and west gradually dying out into the unbroken black of true *multicolor*; whilst the pale colour of the female appears throughout our Survey series all the way down to Salem district. Luckily Mr. Baker has placed his type locality

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as far south as Raipur so the name can be retained though the construction, we placed on it is different.

We propose therefore to recognise the following races.

Ægithina tiphia tiphia (L.).

Motacilla tiphia Linn. Syst. Nat. Ed., x. (1758), vol. i, p. 186,—Bengal, restricted to the neighbourhood of Calcutta.

♂ Summer and winter plumage normally alike a rather dull dark green, the black on the upper plumage in summer being obsolete (Punjab) confined to faint traces of mottling or occasional black feathers (United Provinces) or patches (Bengal). Lower plumage duller and greyer in winter and less bright yellow in summer.

♀ duller and greyer than in *Æ. t. humei*.

The Himalayan foothills and the adjacent plains from Gurdaspur to northern Assam, the United Provinces, and Bengal extending into Burma.

Ægithina tiphia humei Stuart Baker.

Ægithina tiphia humei Stuart Baker, Fauna, B. I. Birds (2nd ed.), vol. i, July 1922 (= August 16, 1922), p. 342—Raipur, Central Provinces.

♂ in summer with black predominant in the upper plumage and often considerable traces of a yellow collar on the hind neck.

♂ in winter plumage and ♀ a clearer and paler green than *Æ. tiphia tiphia*.

The whole of India south of a line roughly from Mt. Aboo through Central India to Orissa.

Ægithina tiphia multicolor (Gmelin.)

Fringilla multicolor Gmelin, Syst. Nat., vol. i, part ii (1789), p. 924—Ceylon.

♂ in summer plumage is altogether a darker bird with the black of the upper plumage more extensive and less broken by yellow bases; the second wing-bar is generally absent. Lower plumage very bright canary yellow.

♂ in winter plumage a darker and duller green, in some specimens washed with black producing a curious sooty appearance not found in the Indian races.

♀ on the average darker than in other races.

Ceylon and Rameswaram island.

Chloropsis aurifrons davidsoni Stuart-Baker.

Chloropsis aurifrons davidsoni; Stuart Baker, Bull. B.O. C., xli. 1920, (Oct.) p. 8—Malabar.¹

Specimens collected.—227 ♂ 15-5-29 Shevaroy Hills 3,500 ft.; 632 ♂ 1-8-29 Palkonda Hills; 966 ♀ Imm. 3-11-29, 980-81 ♂, ♀ Imm. 7-11-29, 1023 ♂ 22-11-29 Nallamalai Hills 2,000 ft.; 1355 ♂ 9-2-30, 1400-1403 ♀♀ 17-2-30, 1404 ♂ 18-2-30 Anantagiri 3000 ft..

Measurements—

	Bill.	Wing.	Tail.	Tarsus,
6 ♂	23-24.5	95-101.5	70-77	18.5-19.5 mm.
4 ♀	22.5-25	91.5-95	68-71	18-19 mm.

In identifying our specimens of the Malabar *Chloropsis* we immediately noticed a distinction in size between the birds obtained in the Eastern ghats and those from Ceylon and Travancore. The latter measure as follows:—

	Bill.	Wing.	Tail.
6 ♂ Ceylon	22-25	91-94	65-70 mm.
4 ♂ Travancore	23-24	86.5-93.5	65-66 "
3 ♀ Ceylon	23.5-24.5	87.5-88.5	59.5-64 mm.
2 ♀ Travancore	22.5-23	87-88	64.5 mm.

There is thus no overlapping in size with our Survey series and it is evident that a large and small race require recognition, in addition to the differently coloured bird of N.-E. India. On the western side where the range is continuous there is a gradual transition in size between the large and small forms, but there is no difficulty in deciding that all birds from the Nilgiris

¹ *Nom. Nov.* for *Turdus malabaricus* Gmelin, Syst. Nat., 1788, p. 837—Malabar, pre-occupied.

northwards belong to the large form. The Palghat gap may therefore for convenience be fixed as the boundary between the two forms, and we propose to name the small southern form.

Chloropsis aurifrons insularis subsp. nov.

Type: ♂ 18-6-1878 Cotta, N. P., Ceylon (Hart Bros.) British Museum, Reg. no.

Although the range of the Malabar chloropsis *C. a. davidsoni* is given in the *New Fauna* as the 'West Coast of India, Khandala to Ceylon', it was already known to occur in the Shevaroyes, whence four specimens collected by Daly are enumerated in Finn's catalogue of the Indian Museum. It has remained however for La Personne to extend its known range to the whole length of the Eastern ghats as shown by the list of specimens. There is, however, some doubt as to the boundary between this and the typical race, as although the latter occurs in Midnapur and Maunbhum there is nothing to show which race occurs at Kalahandi (Ball) and Gumsoor (Jerdon).

In the west of the Presidency this *Chloropsis* is common in Malabar, Coorg, the Wynaad and the Nilgiris up to 6,000 ft.

The female is wrongly described in the *New Fauna*. As in the typical race she agrees closely with the male and is only distinguishable by the smaller, duller patch of orange on the forehead, the smaller blue carpal patch and the slightly smaller size. In first winter plumage both sexes lack the orange forehead, while the black gular patch and blue moustachial streaks are replaced by pale green, though the premature moult of a few feathers usually foreshadows the adult plumage.

The breeding season in the Presidency is unknown. Colonel Sparrow informs us that about Eswantaraopett near Secunderabad nests may be found from the end of June to the middle of August, but that most eggs will be found in early July. In N. Kanara, on the other hand, James Davidson found a nest with young at Sampkund (Sirsi Taluka) on February 18.

Chloropsis aurifrons insularis subsp. nov.

This small race is common in the hills of Travancore up to 4,000 ft. and also apparently in the Nelliampathis. There is no record from the Palnis.

The breeding season in this area is unknown but the *New Fauna* records a nest with two eggs in Ceylon on January 25.

Chloropsis jerdoni (Blyth).

Phyllornis jerdoni, Blyth, *J.A.S.B.*, xiii 1844, (after December), p. 392 Goomsoor.

Specimens collected:—98 ♂ Imm., 20-4-29, 187 ♂ 5-5-29 Kurumbapatti; 350 ♂ 7-6-29, 372 ♂ 9-6-29, 438 ♂ 17-6-29 Chitteri range 2,000 ft.; 522 ♀ 6-7-29 Kalai, Trichinopoly; 832 ♀, 833 ♂ 19-9-29 Kodur, S. Cuddapah; 967 ♂ 4-11-29 Nallamalai Range 2,000 ft.; 1718 ♂, 1719 ♀ 23-4-30 Jeypore Agency 2,000 ft.

Measurements—

	Bill.	Wing.	Tail.	Tarsus.
8 ♂	21.5-24	86-95	67-79	19-20.5 mm.
3 ♀	21-22	84-84.5	68-71	18-18.5 mm.

Jerdon's *Chloropsis* is very widely spread within the Presidency. Although it is common in Chota Nagpur there is little definite evidence in support of Jerdon's statement that it is extremely common in the jungles of the Eastern ghats (Ill. Ind. Orn.). Jerdon himself specifies Goomsoor as a locality (Madras Jour. Lit. Soc., 1839, 247). Otherwise La Personne's specimens (♂ ♀ April 23) from the Jeypore Agency 2,000 ft., from the Nallamalai range 2,000 ft. (♂ November 4) and from the Chitteri range 2,000 ft. (♂♂ June) complete the known records for the Eastern ghats.

In the Carnatic, on the other hand, Jerdon considered the bird as rare, and this agrees with the experience of the Survey. At Kodur, S. Cuddapah, La Personne procured a pair on September 19, noting it as not plentiful, and in Salem District he says that it was not common, isolated pairs being met with over a large area. A female was procured at Kalai, Trichinopoly.

In the west of the Presidency it is certainly more common though perhaps less of a hill bird. Throughout Travancore it is a very common bird in the low country at the foot of the hills but it does not ascend them (Ferguson

J.B.N.H.S., xv. 262). There are 4 specimens in the British Museum labelled Anjango¹ in December 1872 as well as one of Fry's 'Trivandrum' specimens.

In the Palnis, Fairbank obtained a specimen (now in the British Museum) at 4,000 ft. (S.F., v. 406). Kinloch did not meet with this species in the Nelliampathis but it is said to have been observed by Mr. W. A. Hasted at Palmaner, Chittoor District (Baker & Inglis, *Birds of S. India*, p. 23).

Davison did not meet it in the Nilgiris but in the British Museum there are specimens from Kullar (Wardlaw-Ramsay), Coonoor (Day) and the 'base of the Nilgiris' (Hume Coll.). In Malabar and doubtless S. Canara it seems to be generally distributed though there are no records for Coorg and the Wynaad.

The seven specimens labelled 'Madras' in the British Museum (Baber, Elliot, Reeves) may be disregarded.

The general distribution of this species as given in the *Fauna* is correct. Ceylon birds are not separable though they do not attain the maximum length of Indian birds. The bird is strictly resident and the breeding season is a poorly defined one from February to August without any particular difference in any part of the wide range in India.

The juvenile plumage differs from that of the adult female in the absence of the yellow wash on the forehead and in the fact that the green gular patch, the yellow nimbis to it and the blue moustachial streak are all very indistinct and shadowy, blending in with the green of the lower plumage. In first winter plumage both sexes resemble the adult female (the moustachial streak being present in spite of the statement to the contrary in the *New Fauna*) but in the male the gular patch is soon flecked with black owing to the accidental moult of odd feathers.

Microscelis psaroides ganeesa (Sykes).

Hypsipetes ganeesa Sykes, P.Z.S., 1832 (July 31), p. 86—Dense woods of the ghats, [= Mahableshwar].

Specimens collected:—206–208 ♂ ♀♀ 12–5–29, 216 ♀ 13–5–29, 219 O ? 14–5–29, 263 ♂ 21–5–29 Shevaroy Hills 3,500–4,800 ft.

Measurements—

	Bill.	Wing.	Tail.	Tarsus.
2 ♂	27	118–119	99·5–102	16·5–18 mm.
3 ♀	25–26·5	111–115·5	95–101	16·5–17 mm.

The Black Bulbul was only met with by the Survey on the Shevaroy Hills where it was abundant and evidently breeding at about 4,500 ft. It had already been recorded from this range by Daly, 4 of whose specimens are in the Indian Museum. With the exception of this locality and McMaster's unlikely² record from Chikalda on the Gawilgurh Hills in Berar (*J.A.S.B.*, 1871, p. 211), this race is confined to the hill ranges of the Western ghats from Matheran down to Cape Comorin, occurring normally at fairly high elevations.

Within the Presidency it is recorded as follows. In Coorg, according to Betts, it is decidedly uncommon as an occasional wanderer from higher elevations. William Davison found it in the Brahmagiris, but the only record for the Wynaad is a bird in the Bombay Society's collection obtained at Petcholi by J. P. Cook. In the Nilgiris, it is widely distributed and very common on the higher parts from 6,000–8,000 ft., only occurring below 4,000 ft. as a scarce wanderer out of the breeding season. Kinloch found it very common in the Nelliampathis, and in the Palnis and the Travancore Hills it is found at all elevations but is particularly common from 3 000 ft. up to the highest peaks.

Although a resident throughout its range this race must indulge in considerable local movement in the non-breeding season when large flocks collect. Rhodes Morgan recorded how in July in the Bolumpatty Valley he saw them

¹ This locality Anjango on many birds in the British Museum must be regarded with caution. Ferguson (loc. cit., p. 264) explains that there used to be several shikaris at Anjango who made a living by collecting and selling birds from the hills. They never labelled them and always said they were from Anjango.

² It will be remembered that inexperienced ornithologists often confuse Black Bultuls and Drongos.

travelling in vast flights, numbering several thousands, flying westwards in the direction of Travancore. Captain Betts states that they desert the western side of the Nilgiris almost entirely during July and August when the S.-W. monsoon is at its height.

They pair about February and nests may be found from about March until the middle of June; but even during the breeding season the main flocks are said not to break up entirely.

The small series from the Shevaroyes cannot be separated from the birds of the Western ghats. Birds from Ceylon however differ (as hinted by Hume S. F., i. 438) in having a distinctly larger bill. The bill in Indian birds measures for 22 ♂s 26-29, and 12 ♀s 25-28.5 mm.; whereas in 16 birds from Ceylon (sexing not satisfactory) the bill measures (once 26) 27.5 to 32 mms. The wing is also slightly longer up to 128 mm. as compared with a maximum in India of 124.5, Indian males usually being below 120 mm. and Ceylon birds above 120 mm. in wing measurement.

This island race may appropriately be distinguished as:—

Microscellus psaroides humli subsp. nov.

Type ♂ 7-2-1892 Ceylon, Hume Collection, British Museum registered No. 1886 9. 1. 964.

Molpastes cafer cafer (Linnaeus).

Specimens collected:—50, 53 ♂ ♀ 14-4-29, 116 ♂ 23-4-29 Kurumbapatti; 248, 250 ♀ 19-5-29 Shevaroy Hills 4,500 ft.; 486 ♂ 2-7-29 Trichinopoly 1,000 ft.; 557 ♂ 19-7-29 Gingee; 636 ♂ 1-8-29, 698 ♂ 16-8-29 Palkonda Hills 1,000 ft.; 792 ♂ 4-9-29 Kodur 500 ft.; 871 ♀ 3-10-29, 908 ♀ 12-10-29 Seshachalam Hills 2,000 ft.

Measurements.—

	Bill.	Wing.	Tail.	Tarsus.
8 ♂	17-19	91.5-97	77-81	21.5-23.5 mm.
4 ♀	17-18	89-90	74.5-78	19.5-22.5 "

With the exception of the birds from the area north of the river Godavery all Red-vented Bulbuls found in the Presidency agree with the typical form of Ceylon. The species is very generally and commonly distributed except in the hill ranges where the distribution is not easy to define. In the Eastern ghats it ascends as a rule to about 2,500-3,000 ft.

In the Nilgiris, too, it is a bird of lower elevations. William Davison states that it is only occasionally found near Ootacamund but that it begins to get common just above Coonoor at about 5,000 ft. and is very common all down the Eastern slopes. On the western side, according to Betts, it is nowhere very common and does not ascend above 4,000'. Even at the foot of the slopes on the Wynad plateau it is not numerous anywhere south of Gudalur. From Gudalur northwards it increases in numbers till it becomes a common species on the Mysore plains. In Coorg it is not common.

In the Palnis, it is found up to the summits though much commoner on the lower slopes. Yet in the Nelliampathi Hills (Kinloch, J. B. N. H. S. xxvii, 940) and in the Travancore Hills (Ferguson, J. B. N. H. S., xv, 263) it does not occur at all. Davison considered that its absence might be connected with the presence of evergreen jungle and this is probably true. But settlement and the replacing of forest by cultivation and bush jungle must have also much to do with its distribution.

There are few records published on the breeding of this race. About Madras, according to Jerdon, it breeds from June to September. In the west however it is said to breed in February and March in Travancore (Ferguson) and from February to April in the Nilgiris (Cockburn).

A melanistic bird at Madras is recorded (J. B. N. H. S. ix, 224).

Molpastes cafer saturatus subsp. nov.

Specimens collected:—1375, 1379 ♂♂ 12-2-30, 1424 ♀ 22-2-30 Anantagiri 3,000 ft.; 1646 ♀ 2-4-30 1714 ♂ 21-4-30, Sankrametta 3,500 ft.; 1720-1 ♀ ♂ 23-4-30 Jeypore Agency 2,000 ft.

Measurements.—

	Bill.	Wing.	Tail.	Tarsus.
4 ♂	18-19.5	89-97.5	79-89	21-22 mm.
3 ♀	17-18	84.5-93	75-83	22 mm.

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The Survey reported this bird to be very abundant in the Vizagapatam District, both in the hills and plains, and in addition to the localities where the above series was collected it was observed at Waltair and Vizianagram. Jerdon recorded it from Gumsoor. There is no information about the breeding season in this area.

The specimens obtained are certainly not the same as those obtained south of the Godavari river. They are intermediate between *M. c. cafer* and *M. c. bengalensis* resembling the former in their sharply defined cap and black ear coverts and approaching the latter in the darker tint of the body plumage and the small area of white on the abdomen. This intermediate position agrees with that of *M. c. pallidus* in the west of the Peninsula; both forms mask the transition of the small southern bird with its sharply defined cap and black ear coverts into the large northern birds with the cap grading into the colour of the back and the ear coverts brown and sharply contrasted. But as these large northern birds obey the general rule and in the north-west are pale (*M. c. intermedius*) and in the north-east dark (*M. c. bengalensis*) the transitional stages are on the west paler than *M. c. cafer* and on the east darker, thereby being sharply contrasted *inter se*.

The eastern intermediate should also bear a name and as none of the names in the Synonymy refer to it we propose the name *M. c. saturatus*.

Type. V. 1424 ♀ 22-2-1930 Anantagiri. Deposited in British Museum.

We recognise the following Indian races:—

Molpastes cafer cafer (Linn.)

Turdus cafer Linnaeus, Syst. Nat. xii ed., vol. i (1766), p. 295—Cape of Good Hope, (errone), Ceylon.

Small dark race; cap sharply defined; ear coverts black.

Measurements—

	Bill.	Wing.	Tail.	Tarsus.
23♂	17-20	90.5-98.5	74-89.5	21-23 mm.
7♀	17-19.5	88-93	74.5-79	19.5-22 mm.

Ceylon northwards to about Bombay on the west, Nagpur in the centre and Godavery valley on the east.

Molpastes cafer saturatus Kinnear and Whistler. subsp. nov.

Darker than *M. c. cafer*; less white on abdomen; cap sharply defined; ear coverts black.

Measurements—

	Bill.	Wing.	Tail.	Tarsus.
4♂	18-19.5	89-97.5	79-89	21-22 mm.
3♀	17-18	84.5-93	75-83	22 „

R. Godavery north to Maunabhum, extending probably into parts of the Central Provinces.

Molpastes cafer pallidus Stuart Baker.

M. hæmorrhous pallida Stuart Baker, Bull. B.O.C., xxxviii, p. 15, 1917 (Dec.)—Deesa.

Larger and paler than *M. c. cafer* with broader greyish white fringes to the feathers; cap sharply defined; ear coverts black tinged with brown.

Measurements—

	Bill.	Wing.	Tail.	Tarsus.
9♂	19-21	94-101	82.5-95	22-25 mm.
8♀	17.5-19.5	87.5-95	78.5-89	21-23 „

Ahmednagar and Khandesh through eastern Sindh and Rajputana to the foot of the Salt Range, the central and southern Punjab.

Molpastes cafer intermedius (Blyth).

Pycnonotus intermedius Blyth, J.A.S.B., vol. xv (1846), p. 50—Upper Provinces¹ Largest and palest race; cap not sharply defined but grading into the mantle; ear coverts brown.

¹ NOTE.—This name is based on a MS. name of Lord A. Hay's: See Jerdon, B. of I, vol. ii., p. 95 which seems to imply that the specimen came from Wazirabad, to which place the type locality may well be restricted.

Largest and palest race; cap not sharply defined but grading into the mantle; ear-coverts brown.

Measurements—

	Bill.	Wing.	Tail.	Tarsus.
15♂	19.5-22	100.5-110	93.5-103.5	23-26 mm.
10♀	18.5-20	90.5-102	84-96	22-25 mm.

N.-W.F.P., Trans-Salt range plateau, Sub-Himalayan ranges to Naini Tal to the western United Provinces.

Molpastes cafer bengalensis (Blyth).

Pycnonotus bengalensis Blyth, J.A.S.B., vol. xiv, 1845² (after August), p. 566—Bengal.

Large and very dark race; cap not sharply defined but grading into mantle and lower back; ear-coverts dark chocolate brown.

Measurements—

	Bill.	Wing.	Tail.	Tarsus.
11♂	21-23	101.5-106	90.5-99	23.5-25.5 mm.
6♀	19-22	89.5-102	85-93	24-25 mm.

Himalayan foot hills from Nepal to Assam; eastern United Provinces, Bihar and eastern Bengal.

It is impossible to define the ranges of *intermedius* and *bengalensis* very accurately in the United Provinces as they intergrade into each other, whilst there is apparently an area of general intergrading of the races in Central India and the Central Provinces, from which very few specimens are available.

Otocompsa¹ jocosca fuscicaudata Gould.

Otocompsa fuscicaudata Gould, P.Z.S., 1865, p. 664—Madras Presidency; now restricted to Nilgiris.

Specimens collected:—70, 72, 73 ♀♂♂ 17-4-29, 152 ♂ 29-4-29 Kurumbapatti; 209 ♂ 12-5-29, 223 ♂ 14-5-29, 244 ♂ 17-5-29, 253 ♂ 20-5-29 Shevaroy Hills 3,400-4,500 ft.; 409 ♂ 14-6-29 Chitteri range 3,000 ft.

Measurements—

	Bill.	Wing.	Tail.	Tarsus.
8♂	16.5-19	84.5-90	80-85	20-23 mm.
1♀	17	83	80	21

It is unfortunate that by an oversight the *New Fauna* cites 'Madras' instead of the 'Madras Presidency' for the type locality of this Red-whiskered Bulbul. The latter is correct both in Gould's reference and in fact, for about Madras city the form which occurs is *Otocompsa j. emeria*. To prevent a recurrence of this mistake we now restrict the type locality to the Nilgiris where it is certainly one of the most abundant birds.

On the eastern side of the Presidency there is no record of *fuscicaudata* north of the Shevaroy and the Chitteri range where it was common at and above 3,000 ft. It is curious that although a small series was collected at Kurumbapatti by La Personne he did not meet with it again anywhere below 3,000 ft. and we have traced no record of it southwards between Salem District and Rameswaram Island (Hume, S.F., iv. p. 458) or westwards until the Palnis and Nilgiris are reached. In the western side of the Presidency, in contrast, it is probably the most common and generally distributed of all birds, occurring from sea-level up to 6,000 ft.

This race is very catholic in its breeding arrangements. Odd nests may be found in any month of the year and some pairs certainly raise two or three broods in succession. Along the Western coast the main breeding season is chiefly from February till May, with a continuation into June and July. In the Nilgiris the main season is from February to June, and again in September after the South-West monsoon. In the Nelliampathis and Travancore the birds are said to start even earlier, in November and December.

¹ We agree with Sclater (Ibis, 1930, p. 678) in not accepting the change (*New Fauna*, viii, p. 614) from *Otocompsa* to *Elathea*.

The range of this race is really very imperfectly known. It certainly continues common along the Western coast as far as Khandesh and we presume that the birds of the Central Provinces recorded as *fuscicaudata* at Pachmarhi (McMaster, J.B.N.H.S. xxviii, p. 454), as *jocosa* at Chikalda (McMaster, J.A.S.B., 1871, p. 212) and as *fuscicaudata* at Balaghat (D'Abreu, J.B.N.H.S., xxi, p. 1165) are correctly attributed to it. In Rajputana, however, there is a very distinct pale race which we have already separated as *O. j. abuensis* (Bull. B.O.C., cccliv, p. 40).

Otocompsa jocosa emeria (Linnæus).

Motacilla emeria Linnæus, Syst. Nat. x, ed. (1758), vol. i, p. 187—Bengal.

Specimens collected:—553 ♀ 18-7-29, 582 ♂ 22-7-29 Gingee; 628 ♂ 28-7-29, 629 ♀ 27-7-29 Madras; 667 ♀ juv. 8-8-29, 673 [♂] 10-8-29, 702 ♀ 15-8-29 Palkonda Hills 1,000 ft.; 1324 ♂ 5-2-30, 1380 ♀ 12-2-30, 1388-9 ♂ ♀ 14-2-30, 1420-1 ♀ ♂ 21-2-30, 1436 ♂ 23-2-30 Anantagiri 3,000 ft.; 1727, 1728A ♀ ♂ 24-4-30 Jeypore Agency 3,000 ft.

Measurements—

	Bill.	Wing.	Tail.	Tarsus.
8 ♂	17-18.5	80-88	75-84	18-20.5 mm.
7 ♀	15.5-18.5	78-83.5	72-79	18.5-20.5 mm.

The distribution of this race of Red-whiskered Bulbul in the Presidency is not yet fully known. Beyond Jerdon's statement that it is tolerably common in Goomsoor and the Northern Circars we can only say with certainty that the Survey found it extremely common throughout the hill tracts of Vizagapatam, keeping to the wooded parts and not descending below 2,500 ft. Here they breed in the Lantana scrub which of late years has invaded these areas. The Survey also found it common in the Palkonda Hills but rare on the Seshachalam range.

Specimens collected at Madras and Gingee also belong to this race which here attains its southern limit. It is noteworthy that the Survey specimens from this southern area Palkonda-Madras show very little passage with *fuscicaudata*. At most they are only very slightly smaller with the white tail tips perhaps a trifle diminished. True intermediates do not appear to exist.

Throughout its whole range the Bengal Red-whiskered Bulbul breeds from early March to late September but most birds lay from April to June and after July nests are rare.

We do not feel at all sure that the Red-whiskered Buleuls of the Duars of the Eastern Himalayas can be kept with this race. They appear to be both larger and more richly coloured but on the material available we do not feel justified in separating them, more especially in view of the paucity of information as to the distribution of this bird in Bengal territories.

Otocompsa flaviventris flaviventris (Tikell).

Vanga flaviventris Tickell, J. A. S. B., vol. ii, 1833 (after Nov.), p. 573 Dampara in Dholbhum.

Specimens collected:—1407 ♂ 18-2-30, 1759 ♂ 3-5-30, 1767 ♀ 4-5-30 Anantagiri 3,000 ft.; 1717 ♂ 23-4-30 Jeypore agency 2,000 ft.

Measurements—

	Bill.	Wing.	Tail.	Tarsus.
3 ♂	15-16	90-92	84-88	15.5-17 mm.
1 ♀	14-5	84	81	16.5 mm.

These specimens constitute the only records of the Black-crested Yellow Bulbul for the Madras Presidency and a slight extension of the distribution in Chota Nagpur where it is known to occur in Dholbhum and Singhbhum (Tickell), Kalahandi and Orissa S. of the Mahanadi (Ball) and Kutri, Daspalla, also S. of the Mahanadi (Walton).

Iole icterica (Strickland).

Criniger? ictericus Strickland, Ann. Mag. Nat. Hist., vol., xiii (1844), p. 411—East Indies?—Mahabaleshwar.

Strickland in his description stated that he believed the bird to have been brought from the East Indies, but that he did not know the precise habitat.

In the catalogue of the Strickland Collection, p. 98, the specimen is given as 'a' (Askew) 1839. The type locality has since been given by Stuart-Baker Handlist, p. 43, as Mahableshwar and we accordingly so restrict it.

The distribution of the Yellow-browed Bulbul lies to the west of the Presidency, out of the path of the Survey.

In Travancore it is confined to the hill forests, occurring according to Ferguson from the foot of the hills to 2,000 ft. in the south, above this in Pirmade and the Cardamum Hills and still higher in the High Range. In the Palnis it occurs from 3,000 ft. upwards. In the Nelliampathis it is extremely common.

In the Nilgiris it is found from the foot of the hills upto about 6,500 ft. (W. Davison)¹ but is not found on the plateau. It extends through the Wynaad and the Brahmagiris to Coorg where it is still common. From here it extends further north out of our boundaries up to Mahableshwar.

Throughout its range from Ceylon to Mahableshwar no races can be defined of this species.

Pycnonotus xantholaemus (Jerdon).

Brachypus xantholaemus Jerdon, Madras Jour. Lit. Sci., xiii, 1844 (after November), p. 122—Eastern Ghats west of Nellore.

Specimen collected :—358 ♂ 7-6-29 Chettiri range 2,000 ft.

Measurements :—

Bill.	Wing.	Tail.	Tarsus.
17.5	90:	86	20 mm.

We are unable to trace the records on which the *New Fauna* states that the Yellow-throated Bulbul occurs in Mysore and Travancore. The only recorded localities for this little-known species are the following :—

1. Bellary :—About twenty pairs observed in June 1901 and c/2 incubated eggs found on June 23 (Col. C. L. Wilson, J. B. N. H. S., XVIII, p. 907).

2. Horsleykonda :—Not uncommon in May 1908 and c/3 eggs found on May 15 and c/2 eggs on May 20 (Roscoe Allen, J. B. N. H. S., xviii, p. 905). A specimen, now in the British Museum, obtained with its eggs in May 1904 by the Rev. H. H. Campbell. This is probably the locality in 'The Eastern ghats west of Nellore' where Jerdon obtained his type specimen.

3. Chettiri range 2,000 ft.—As above. This was the only specimen obtained but La Personne is under the impression that he overlooked others, confusing them with *P. luteolus*.

4. Sankaridrug, Salem District :—A specimen obtained on September 14 1902 by D. G. Hatchell is now in the Society's Collection.

5. Anamallai Hills :—One obtained by William Davison, the only one seen in two weeks, at 4,020 ft. almost as far north as 10° N. and considerably to the west (Ibis., 1886, p. 146).

6. Three more specimens in the British Museum and one in the Indian Museum are labelled 'Madras' or 'Eastern ghats' without precise localities.

The iris is said by Roscoe Allen to be brown and not bright red as recorded.

Pycnonotus gularis (Gould).

Brachypus gularis Gould, P. Z. S., 1835 (after November), p. 186—Travancore.

In Gould's original description the type locality is given as 'in India orientale apud Travancore', the wider sense of East Indies of course being the correct translation.

The Ruby-throated Bulbul has a very limited distribution in western India from N. Kanara southwards. Within the Presidency it is found in Coorg (Betts, J. B. N. H. S., xxxiii, 544) and in the Wynaad (Davison S. F., x, 384), in both of which areas it is by no means common. In the Nilgiris, Betts only met with them at the foot of the hills in the Ochterloney Valley (J. B. N. H. S., xxxiv, 1028). There are specimens in the British Museum from 'Malabar Coast' and Calicut. One was seen in the Nelliampathis by Kinloch on 24th 'near the top of the northern slopes' (J. B. N. H. S., xxviii, 280). A female obtained by W. Daly on Mt. Stewart in the Anamallais is in the Indian Museum. Fairbank

¹ According to Betts (J. B. N. H. S., xxxiv, 1027) it does not occur above about 4,500 ft.

obtained a single specimen at Vengayam Parry in 1867 in the Palnis, but was never able to meet the bird there again (S. F. v, 405). In Travancore according to Ferguson (J. B. N. H. S., xv, 264) it is not common but he found it in open forest at the foot of the hills and also in thick forest about 2,000 ft., while he mentions the Ghat road to Pirmade as the best locality for it.

***Pycnonotus luteolus luteolus* (Lesson).**

Hamatornis luteolus Lesson, Revue Zool., December 1840 (January 1841), p. 354—India, Bombay.

Specimens collected:—11 ♀ Imm. 10-4-29, 79 ♀ 18-4-29, 165 ♀ 1-5-29 Kurumbapatti; 278 ♂ 24-5-29 Shevaroy Hills 4,000 ft.; 342 ♂ Imm. 6-6-29, 362 juv. 8-6-29 Chitteri range 2,000 ft.; 501 ♂ Imm. 4-7-29 Kalai, Trichinopoly; 543 ♂ 17-7-29; ♀ Imm. 19-7-29 Gingee; 699 ♀ 703 ♀ imm. 16-8-29 Palkonda Hills 1,000 ft.; 860 [♀] Imm. 1-10-29 Seshachalam Hills 2,000 ft.; 1031 ♂ 25-11-29 Nallamalai Hills 2,000 ft.

Measurements.—

	Bill.	Wing.	Tail.	Tarsus.
5 ♂	18-20	86·5-90·5	75-85	21·5-22·5
7 ♀	18-19	82-85·5	74-82	20·5-22·5

Although no specimens were procured by the Survey north of the Nallamalais the White-browed Bulbul, which is common in Orissa in a broad zone described by Ball (S. F., iv. 235, v, 417), is found in Goomsoor and throughout the Northern Circars according to Jerdon. From thence it extends all down the eastern side of the Presidency, certainly as far as Trichinopoly. In the central Carnatic, that is from Madras to Salem it is excessively abundant occurring in every patch of jungle and every hedgerow. To use La Personne's expressive phrase, there is hardly a patch of 10 square yards without a White-browed Bulbul in it, generally in the heart of the bushes. It occurs from sea level up to 4,000 ft.

In the west of the Presidency it is less abundant, the more humid hills of this area being apparently an obstacle to it. It does not ascend the Palnis though it is common at their east base. In Travancore Ferguson only obtained two specimens, in the low country near Cottayam in August 1893 (J. B. N. H. S., xv, 264), and there is another from Trivandrum in the British Museum, obtained by Bourdillon on November 16, 1878. North of this I have only records from Coimbatore (Jerdon), Malappuram (Sparrow Collection), Coonoor (Wardlaw-Ramsay) and Wynaad (Hume S.F., x. 384) and it is evidently scarce in this neighbourhood.

There is no information on record about the breeding season in most parts of India. Betham found 2 clutches of eggs in June at Baroda (J.B.N.H.S., xi, 316) and D'Abreu states that it breeds in June at Kamptee. About Bombay it breeds during the rains in July and August (Barnes), April to July (Stuart Baker) and one egg September 14 (E. H. Aitken).

We can detect no variation in the wide range of this species in India but agree with Stuart Baker (*new Fauna* i, 417) that birds from Ceylon are smaller. We measure a series from India as follows:—

	Bill.	Wing.	Tail.
16 ♂	18-20·5	85-91	75-85 mm.
8 ♀	18-20	82-85·5	74-82 "

Whereas 7 birds from Ceylon (sexing indifferent but both sexes included) measure:—

Bill.	Wing.	Tail.
18-19·5	77·5-84	68-76·5

They are also slightly darker than Indian birds. We are of opinion that this island race should be recognised and propose for it the name.

***Pycnonotus luteolus insulæ* subsp. nov.**

Type ♀ 8-4-28 Tellula, Ceylon (W. P. Lowe). British Museum Reg. No. 1928. 6. 25. 46.

***Microtarsus poiocephalus* (Jerdon).**

Brachypus poiocephalus Jerdon, Madras Jour. Lit. Sci. vol. x 1839 (after October), p. 246—Peria Pass, Malabar.

The above spelling was corrected by the author to *poioicephalus* (Ill. Ind. Orni. pl. xxxi). Stuart Baker is in error in giving the type locality as Travancore. Jerdon says clearly 'I only once procured this species of Bulbul in forest at foot of the Persia pass leading from Malabar to Wynaad.' Persia is evidently a misprint for Peria.

This is another Bulbul with a very limited distribution along the south-western side of India from Belgaum to Travancore, where it is a bird of deep and swampy jungles.

In Coorg the Grey-headed Bulbul is common (Betts, J.B.N.H.S., xxxiii, 544). In the Wynaad it is fairly generally distributed and in some localities not uncommon, such as Manantoddy and the Peria forests. In the Nilgiris it is generally overlooked though William Davison procured a specimen near Coonoor (S.F., x, 384) and Cardew found it not rare on some of the slopes about 4,000 ft. (J.B.N.H.S., x, 147). In Malabar Jerdon gives Honore as a locality and there is a specimen from Cannanore in the British Museum.

In Travancore it occurs about 2,000 ft. and Ferguson remarks that he only met with it in one locality in the plains, Kuttanyi, an exceptional place where the old forest was still standing. The locality 'Anjango' on the specimen in the British Museum is doubted by Ferguson who remarks it is applied loosely to specimens procured by the professional native skin collectors of that place on their trips to the hills.

Salpornis spilonotus spilonotus (Franklin).

Certhia spilonota Franklin P.Z.S., 1830-31 (1831, Oct. 25), p. 121—Between Calcutta and Benares and in the Vindhyan Hills between the latter place and Guru Mundela.

The Spotted Grey Creeper is not a bird of alluvial plains and is more likely to have been obtained in the second part of Franklin's trip. We therefore restrict the type locality to the Vindhyan Hills.

We can find no authority for the statement (Baker and Inglis, p. 31), that this bird 'occurs rarely on the extreme north-west of Madras.'

If the records are collated and plotted on a map it will be found that the mystery with which most writers surround this species is quite unnecessary. It has already been divided into two races by Meinertzhagen (Bull. B.O.C., xlv, 1926, p. 83). *S. s. rajputanae* is confined to the Aravallis and adjacent jungles from Mt. Abo up to Gurgaon. The typical race is far more widely spread. Hume stated (S.F., iii, 462) that it occurs in the Sub-Himalayan forests. This is correct but we know very little about the species in this area. Adams says (S.F., i, 375) that he shot two from a party of six at Moteepur village, Baraich District in 1868. Hodgson had two specimens taken by himself or his collectors in the Terai of Behar and one of these is still in the British Museum as well as a specimen collected at Gonda by Pinwel.

The typical race also occurs across the centre of the Peninsula from the Narbudda to Chota Nagpur extending southwards to Ahmednagar on the west and Sironcha and the great forests of the Pranhita in the east. In these forests and in the Satpuras it certainly cannot be regarded as rare.

(To be continued.)

OLD DECCAN DAYS¹.
MY TIGER-HUNTING JOURNAL IN 1899.

BY

BRIGADIER-GENERAL R. G. BURTON.

On March 18, 1899, having two months' leave, I left Jalna, travelling in a truck on the Hyderabad-Godavery Railway, then under construction, and next day reached Warora, the terminus of the railway that now runs through the Chanda District. I was joined en route by my brother E. B. B., and we drove on to Chanda in small carts drawn by trotting bullocks. Next morning we rode eighteen miles to Chandur, in the Nizam's Dominions beyond the Wardha river. It was in the neighbouring villages that the man-eating panther described in Vol. IX of the Journal by the late Mr. Inverarity, a fine sportsman, had committed its depredations five years before. Our camp, which had been sent on ahead, was pitched on the bank of a considerable watercourse which, with its tributaries, drained the range of mountains running East and West, the watershed sloping northward to the Wardha and on the south to the Godavery. The mountains just above the camp culminated in a peak crowned by the great fort of Manikgarh, hoary with age and at one time bristling with guns, but now abandoned to the wild beasts. To the south stretched for many miles a tumbled mass of jungle-clad hills, largely uninhabited but in the valleys containing one or two considerable towns, such as Jangaon, as well as innumerable hamlets inhabited by aboriginal Gonds who formerly peopled the whole of this part of India.

In the afternoon I tramped out seven miles up the main nullah to Kosambi. Water and cover were plentiful. I found tracks of a tiger and two tigresses, and with dry grass took the measurements of their pugs for purposes of identification, in order to ascertain the numbers of the tiger population. I picketed a number of heilas (young buffaloes) and got back to camp at dusk, very footsore, having covered well over 15 miles. Next day there was no kill and we picketed out more heilas. In the afternoon we went out towards the hills and saw a sambar stag, but did not get a shot. We were following the sambar when a herd of spotted deer appeared and saw us as we crouched. They were all hinds; they came walking out of the jungle towards us, the leader barking at intervals, and all approaching within about thirty yards. When we moved on they followed, barking, for some time. Some gazelle were also seen.

Again next day there was no kill. There was so much jungle that it was difficult to locate animals; but we tied up more heilas, making 11 in all. Next morning, March 24, three had been killed

¹ The first article appeared in vol. xxxiii, No. 1, p. 26.

by different tigers. The nearest was by Manoli, about two miles from camp; the next a mile and a half farther on up the main nullah, and the third seven miles off at Kosambi. We beat in succession from the first. Soon after the beat began I saw a tiger come up behind trees in E.'s direction, but he suddenly turned back, and soon afterwards he roared and E. saw him galloping across open ground 200 yards off. I thought he had gone, but the uproar of the beaters on that side turned him back, and he came trotting up the nullah straight towards me, looking very angry. I dropped him close by with a broken back and finished him off with a couple more bullets. Soon afterwards a spotted stag galloped along the bank of the nullah 60 yards to my left, where I shot it dead; it dropped from the bank into a pool of water, where both its antlers fell off. This was curious for they should not be ready for casting but should be just mature. We went on to beat the next place, and late in the beat a tigress walked out of the jungle in front of me, and stood broadside on in the open for some time 40 yards off; then she dashed forward between us with a roar; E. rolled her over with a shot in the neck, and I finished her with one between the shoulders. It was now too late to go on to Kosambi, and we returned to camp.

Next morning we took beaters and started for Kosambi at 7 o'clock. Here was a fine bamboo jungle with plenty of water and dense cover. The tigress was roused with difficulty. Then she roared on the left of the beat where she tried to break up hill but was turned by a Gond with volleys of abuse and much whacking on his tree with a stick. Soon afterwards she walked slowly out and turned her flank to me about fifty yards off, and I shot her dead with a bullet through the shoulder. She broke some of her teeth, biting the rock close by in her dying agony. She was a young tigress, fat and in good condition. Next morning, thinking we had killed all the local tigers, we beat a hill above the camp, posting ourselves on the crest and a bear was hounded from his lair and added to the bag when he broke cover near E. In the evening we were just going out to shoot a peacock for the pot, when a Brinjara came to say that a tiger had killed a cow lower down the nullah near Dhamangaon. It was getting late, but we hurried to the place and got into trees over the kill, which had not been eaten. We sat about an hour after the moon rose, and then returned to the tent. In the morning I sent the camp on 12 miles to Sondo, and went to look at the kill. The tiger had returned to feed during the night, and had torn out an unborn calf which lay beside the remains of the cow. Jackals and crows were at work on the kill, so the tiger, a very large one from the pugs, was not close by. I tracked him to a pool where he had drunk water and turned back. I ringed the whole cover, and found no marks of egress, so we beat the place, but found no tiger. We left him for future operations and rode off to Sondo, 15 miles or more, having lost our way in an extensive forest. The measurements of this tiger's pugs corresponded with those of the tiger first killed. I shot him on the return journey.

There used to be bison here, but they had all died from foot and mouth disease. The camping ground under tamarind trees swarmed with ticks. The country was bare and waterless. Next morning a

kill was found about half a mile from camp in bamboo jungle where all the grass had been burnt. The beat was empty. Tigers were in the habit of lying up among the rocks that formed the chief feature of the ground, but the tigress had gone off up the bank of the watercourse; we followed for some distance, and decided that it would be best to sit up over the kill as it was a moonlight night. E. sat up, but the beast did not come back. The country here not being very promising, I sent the shikaris on to Ghat Jangaon, two marches to the south, and on the 30th we marched 15 miles to Bimbara.

Shortly after leaving Lakarkot (two huts and a good well in the jungle) we entered a mountain pass about a mile long. Here very heavy rain came on, and it poured for hours. We got soaked and arrived at Bimbara in a bedraggled condition, and put up in a house kindly placed at our disposal by the Gond Raja Sakharam. The village is a good-sized Raj-Gond one, better built than most. We undressed and wrapped ourselves in blankets, and dried our clothes at fires lighted in the house. Three carts got in at 7, having started at 12 o'clock. The camels could not get through the pass; one slipped and fell down the precipice and was killed, and the other was lost. Carts were sent from Lakarkot and Bimbara, and the kit was brought in; the missing camel was found next morning. We left Bimbara at 9 in the morning, having had every assistance from the Raja and his people.

We passed through Wakri, where a tiger was reported to be in the vicinity, and rode on eight miles to Ghat Jangaon. Here there were said to be several tigers not long since, but much rain had fallen, reports were not satisfactory, and we found only old tracks of one tiger. In the afternoon we went out across the river which held running water, on the banks were numerous peafowl and junglefowl. In the jungle on the far side we put up two sambar stags, but did not see them; also a chital stag which I missed with a running shot. Next day we rode on to Jangaon, where I had camped and shot three or four tigers two years before; and where the camp was joined by a good shikari, Mir Sahib, whom I knew.

I went to picket heilas at Samela, a few miles off, and E. went out and shot two gazelle. There was no kill next day, and I tied up more heilas as far as Paharibanda. Much of the cover in the neighbourhood had been cut down since my last visit. On April 3, there was a kill in Gadranghat near Samela, where I shot a very big tiger in 1897. The cover was extensive and the beat difficult to arrange. The beat had gone on for some time, and many peafowl had come out, when a tigress broke from the cover in front of me and was crossing the river, coming in my direction when a foolish stop on my left began knocking on his tree, and turned the beast across the stream again. Fortunately she was turned back by the stops on the other side, and came out to E. He shot her through the body, and she disappeared in the cover. I knew there was a pair, and in about ten minutes the tiger came out and took the same line as the tigress. Exactly the same thing happened; the same stop turned him, but he was driven back again, and E. shot him; he disappeared in the same bushes as the tigress. I got down from the bank on which I was posted, and we walked up the tigers and

found them both dead. After the beat two Gonds came up from Paharibanda and reported that a heila had been killed by a tiger during the morning. This was six or seven miles off.

We beat the Paharibanda cover at noon next day. I had killed a tiger here in 1897. Now a tiger soon came out to E., who knocked it over. It got up, spun round and round, and I fired a shot that broke a hind leg; I was about seventy yards off. It then scrambled up a big ant-hill at the foot of a tree in which E. was sitting only twelve feet from the ground, and the tiger was consequently now quite close to him. It tried to get at him, and might have pulled him down but for the broken leg. It seized the small charpoy, generally used as a machan, but on this occasion left on the ground below, and jumping about with it, bit and clawed it, growling angrily. However E., who had some difficulty in reloading, put in another shot, and the tiger died with the charpoy in its jaws.

Next day we sent the camp on some miles to the south, to Burjum, where there were tracks of a tiger all along the road. It had lain down not far from one of my heilas during the night, but had not killed, perhaps because the heila had not betrayed its presence by any movement. The shikaris declared that this was due to 'jadu', a spell having been cast over it, and they changed it for another. This was wild country, with very dense jungle and plentiful water; there were many chital, and a herd of bison was said to be in the neighbourhood. There was a kill on April 7. But the location of the tiger was misunderstood and the beat badly arranged in consequence, guns and stops being too close to the kill. The tiger, which had been lying in a pool of water, was disturbed and went off with a rush and a roar before we were ready to begin the beat, and we could not find him. He killed again that night, but had left the carcass and gone off to a distance.

On April 9, I sent my men to Balanpur, and we marched 14 miles on the way, to Woadam, and next day 9 miles on to Balanpur. We caught some small fish in a pool in the stream with fly. There were tigers about here, where I killed three tigers on a previous visit, but the rain had dispersed them and there were no fresh tracks. On the 11th there was a heavy thunderstorm; these storms came on every evening, and rain was falling in the mountains. This made it difficult to mark tigers down. They wandered over the hills, whereas if the season had been normal, they would doubtless have remained in the river beds, where cover and water were plentiful. The weather was quite cool, as it had been since we left Sondo. On the evening of 13th the moon was visible at fitful intervals through the massed clouds; in the far distance flashes of lightning proclaimed thunderstorms in several directions, but no rain fell in camp.

Next morning a kill had taken place at Mohar, and we rode out to the big banyan tree there. A new village was in course of construction. The kill was a mile off on the left of the road. A tigress came out early in the beat, going towards E., so I did not shoot it; then another came along the bank of the nullah opposite to me, and I dropped it dead in its tracks, about 80 yards off. A third tiger came and turned down into the nullah below me. I shot it through the back,

and it charged straight up the bank on the top of which I was sitting ; roaring fiercely, it was some fifteen yards off when I rolled it over with a bullet that went in at the neck and came out under the skin of the rump. The first animal had gone off past E. without giving him a shot, as it kept in cover. These were two almost full-grown cubs, a tiger and a tigress ; the mother had escaped. After the beat heavy rain fell, the sky clouded over, and lightning was flashing among the distant hills.

A panther prowled round the camp at night, disturbing us with its grating cry. That night there was a kill in a branch nullah to the south, opposite the great banyan tree. The buffalo was heard bellowing and the attacking tiger roaring during the night. The jungle was very thick bamboo, and the beat was arranged with difficulty, as we had to beat an extensive hill side. Two tigers soon made their appearance ; they came across my front some distance off, seen at intervals through the bamboos, and were turned by a stop towards E., who was out of sight on the bank of the main nullah. The tigress galloped past him, and he could not get a clear shot and missed her. The report turned the tiger back ; he crossed fifty yards in front of me, executing a kind of gambado, jumping about and roaring ; I shot him through the shoulder, and he dashed back towards the beaters. I stopped the beat by whistle signal and walked after him, and found him dead against a clump of bamboos. This made a bag of nine tigers in three weeks, a good average. But for the rain we would probably have got the last three sooner.

Next day there were two kills, one in the bed of the main nullah by yesterday's tigress ; and one in the place where I shot the two, no doubt by the one that escaped. We beat the former cover first. The tigress sat still in very thick jungle until the beaters came close up, and then broke back with a rush and a roar through the middle of the crowd. It was fortunate that none were killed. She was evidently angry after yesterday's fracas. We then beat the other place, but the beast was wary and had left during the night. Next day we sent the shikaris on 30 miles to Utnur, where I shot three tigers in 1897, and at midday I walked a long way over the hills. About a mile from camp I put up a large sambar stag which was lying in the grass among some trees, and shot him as he ran. He had short but massive antlers.

Having collected 24 men to carry the baggage, we left Balanpur at 6 a.m. on April 15 and climbed the ghaut to Kakarbardi in about two hours. Here we were met by carts, on which we loaded the baggage and then marched on 14 miles to Usegaon. The carts got in at 4 o'clock, having been delayed in changing bullocks at every village en route. We marched by a mountain path next morning and reached Utnur at 9 a.m. Tigers had dispersed after the heavy rain, and only old marks were to be found. There were here three fine lakes, on the largest of which were a lot of whistling and cotton teal, and I also saw a pack of common teal. The Shampur nullah, where I shot two tigers on my last visit, had been cleared of jungle and spoilt. The village of Shampur was deserted. In the evening we shot some teal ; the sky then grew inky black, and there was thunder and lightning in the surrounding mountains. At nine rain began to

fall and a steady downpour continued for some hours. The Gond Raja, an old friend, and his son called this day, and we returned his visit. He lived in a small house built amid the ruins of the old fort, where his ancestors who once ruled the country had resided for many generations. They had made the great dam which held in the water that formed the big lake, and giant banyan trees, the growth of centuries, were now growing all along it.

Green grass growing a foot or more in height everywhere showed that much rain had fallen. I was told that before the rain bison came nightly to feed in the rice-fields below the bund of the lake but they were not now coming as there was plenty of grazing in the jungle. We walked out through some fifteen miles of forest to the south to look for bison; there was said to be a herd and a solitary bull, but we found only old tracks and the jungle seemed to be singularly destitute of game. We saw only a chital hind. It rained nearly all night, just like monsoon weather, most unusual at this season. However next morning there was a kill in the Durgapet nullah, but the tigress went out through the stops, and was viewed only a couple of hundred yards off, going fast, tail in air. That night a tremendous thunderstorm came on and flooded us out of our tents. We moved into some deserted Hindu temples, of which there were three, one built on granite columns, an excellent residence. In front was a mosque in which my sepoy took up their abode. The oldest inhabitant said that this also was once a Hindu temple, but the Muhammadans had taken a cow and cut its throat there and so desecrated the whole group of buildings. However, the two creeds seemed now to be at peace, and the Raja's 'prime minister' was a Mussalman. In a thicket close by I found the remains of a calf killed by a panther which, I was told, had gone into a hut at Pangri a few miles off where a woman, a child, and a dog were sleeping alongside each other. The beast seized the child and dragged it some distance before being driven off. There were tigers about, and one was heard roaring on the 22nd, but they wandered far in this cool weather when there was water everywhere. We fished several times in the lakes, and caught a number of small fish of various kinds. One might spend a very pleasant month at this place, fishing and shooting, especially if one had a boat. There were large murrell and piran in the lakes as well as many crocodiles, and there must be plenty of wildfowl in the cold weather. One night a heila was killed by wild dogs in the Durgapet nullah. We left Utnur on April 25, went up the mountains and marched 28 miles to Dhobia, arriving at 9-30 p.m. Next morning we went on to Ara, about 20 miles. There was no village between the Gond hamlet of Dhobia and Kolari near Ara. The whole country along the river between Ara and Nagalgunta was deserted. It contained some fine jungle, but these great uninhabited forests are not good for tigers, nor can beaters be obtained. There was, however, some good ground near Dhobia, and the nullah running down from that place to Kéri Meri contained several tigers. On the road beyond Dhobia we saw tracks of a tigress and cubs which had passed by in the night. And farther on the way we found marks of a tiger and a tigress and old tracks of a bull bison.

It was scorching hot on the way to Ara, where we arrived at three o'clock, but the baggage did not come in until seven.

The road down the mountains below Dhobia was very bad, difficult for both carts and horses. Rain had fallen everywhere; the ground was carpeted with long green grass, and nearly all the trees had burst into foliage, giving the jungle the aspect it wears during the rainy season, and all most unfavourable for the purposes of the expedition. Next morning we went a long round and picketed heilas in many good-looking spots. A cow had been killed a mile from camp, but we saw from tracks that it was a panther's kill. A villager said there was a pool of water in the hills. I went a few miles to the head of a deep ravine and found four-day-old marks of a big tiger which had drunk at the pool and had lain down in the grass close by. I tied up a heila. The jungle was very dense and mostly bamboo, and all green after the heavy rainfall. On April 29, it was cool and cloudy.

We discovered a wild Gond living with his two wives and children in the jungle near Kolari. A rupee and a tot of whisky were administered to and appreciated by him. This Kanha was a veritable wild man of the woods. He told me there were some bison in the neighbourhood, and one solitary bull which he saw attacked by a tiger who got the bull by the throat but was flung off and put to flight. He said that this tiger attended him when he was out hunting, and that whenever he shot anything the tiger came straight to the sound of the gun in order to try and get the game he killed.

On April 30, I got up at 4-30 and walked three miles to Kolari where Kanha the wild Gond met me. Some miles farther on we turned in towards the hills, at the foot of which were many tracks of bison, including the solitary bull, but none less than three days old. We climbed the hills and went along the top for some miles but saw only four hornless sambar; one was lame, and apparently had a broken leg, which Kanha said was the result of one of his shots. There was very dense and extensive jungle at the foot of the hills, and the bison may have been in this, but Kanha declared they had been frightened off the ground to a distant jungle by a tigress whose tracks I saw on the road below. On reaching camp at midday, I found news had come in from Samela, near Jangaon, where I had a picket posted, that there had been a kill in the night. We started at 12-30 and rode ten miles to Samela. The kill was half a mile up the nullah from the place where we shot the two tigers on April 10, and where I killed a very fine tiger two years before. This latter had splashed through the water and climbed the bank at my feet about ten yards off, and rushed into dense cover when shot through the body. Following on spots of blood I found it dead about a hundred yards on, stretched across a small nullah.

We now arranged a beat down the main nullah, E. being posted in the best spot where he had an extensive view. The tiger came within a hundred yards of him and then turned up the bank. Fortunately I had placed here my sycé, a very reliable stop, who just broke a stick, the crack of which was enough to turn the tiger down again. It then stopped some time in long grass in front of E. until the beaters approached, when it came on and he shot it. He was at the

bottom of the nullah in a tree, and the smoke hung so that the tiger could not be seen lying dead for some time, until the air cleared. This was one of the few occasions on which I have known inconvenience caused by using black powder. We both shot with Holland 500 Express rifles, taking five drams of powder and a 440-grain bullet. The cover was very thick after the heavy rain. It was in this nullah, I was told by Mir Sahib, that Colonel Ludlow, late Inspector-General of the Nizam's Police, had a shikari killed some years before. The colonel had knocked over the tiger and told no one to go near it, as it was still alive. A Rohilla went up to it and was fearfully mauled and died the same night.

On the way back we found tracks of a tiger on the road two miles from camp. The day was very hot, and the weather showed signs of improving, the wind having changed. The tiger we had shot this day was old and thin; he had no fat, and his jaw was furnished with long yellow fangs, one of which was broken. At night when lying awake I heard peafowl calling; probably a tiger was on the prowl. In the morning I was taken very ill, perhaps from eating fish caught in the nullah. There was a kill near Indani, in a watercourse running from the north, by the big tiger of Ara. The beat was an easy one, and the tiger should have been killed without difficulty. But after the stops had been posted, one of the shikaris, who often made mistakes, went too close to the bank of the watercourse and disturbed the tiger, which went off at once. That night the same tiger was prowling, and I could follow his track by listening to the call of the peafowl taken up in one cover after another. There were three kills, one in the hills, one ten miles off at Samela, and one in the Nisani nullah, seven miles off, by the Ara tiger.

We rode off to Samela, where the kill was close to the scene of the last tiger's death. But we beat all the neighbouring cover in vain. I heard a peafowl call at one point, and the tiger must have sneaked off to some distant cover. I had got to Samela with difficulty, having a bad attack of fever, which necessitated a halt of an hour on the way. Next morning, May 3, we started at 9 o'clock to beat up the Ara tiger at Nisani. I had a terrible attack of fever on the way, but was supported on my horse by two men, and on arrival sat on the steep bank of a wide nullah, while E. and the shikaris arranged the beat. Soon after the beat began a fine tiger came through the bamboos behind me; he had tried to break out, but had been turned by Rajaram sepoy, and now, panting heavily, trotted close past where I sat hidden by a clump of bamboos, and rushed down the steep bank below; I knocked him over with a bullet that broke his back, and finished him with another shot. This was one of the best I have killed; he was very heavy and powerful, with a great ruff round his head, 9 feet 4 inches in length. My measurements were always taken between upright pegs at the nose and tail, and the longest tiger I killed in the Deccan was 9 feet 8 inches long, including 3 feet of tail; but the biggest skull of those killed this season belonged to the 9-foot tiger shot on April 30.

It is a curious circumstance that the fever had passed off by the time this beat was over, and I was able to ride six miles to look for the tiger which had killed a heila in the hills. The beat was very

difficult in extensive and intricate jungle and almost impracticable ground; the tigress went out to one side, and was not seen. Another kill took place at Samela next day, but this was by the tiger we had already hunted more than once, and he did not stay in the cover, so we went ten miles and back to no purpose; I then withdrew my picket from Jangaon. On the 6th we sent the shikaris on to Sondo on the return journey, and in the evening went out up the Ara river, where we saw only spotted deer and peafowl. This was one of the most beautiful watercourses I have seen, having great forest trees on either side, the deep stream flowing between banks clad with bamboos and carpeted with verdure.

Next morning we started at 4-30. Rain was again falling; we marched 14 miles to Bimbara, and on May 8 to Sondo. Here there were no signs of tigers, and we moved camp next day to Chandur. The Lakarkot pass, where our camel fell and was killed as already related, was again flooded, and on the way to Chandur we were drenched during a tremendous thunderstorm. There was a kill by a panther in the main nullah, and my shikaris saw a pack of about 30 wild dogs in full pursuit of the panther which they had driven from its kill. They had apparently denuded the jungle of game. In the evening I saw a wild dog and pup at the remains of the kill, and made a bad miss; the dog gave vent to a cry when fired at.

On the morning of the 11th we walked eight miles up the nullah. One of our heilas had been killed by wild dogs, but there were no tracks of tigers. However, there was a kill beyond Kosambi, at the head of the nullah, on the 13th. In the beat the tiger soon put in an appearance, his presence being announced by the swearing of monkeys in the trees. He tried to break out to my right, and was only turned back after a great deal of noise by sepoy Rajaram and other stops in the trees, in front of whom he remained quite five minutes roaring fiercely at intervals. At length Rajaram threw his shoes at the tiger, which galloped out grunting angrily, straight towards me. I shot him through the head and he plunged forward sprawling for five yards, when a shot in the neck finished him. He was a fine old tiger with a light-coloured coat, nine feet three inches long. I cut off his head, which now hangs in my hall. This finished the expedition. On May 17, I was back at Jalna, where I was at once laid up for sixteen days with fever. In those days I took no mosquito curtains in to camp. It was generally supposed that mosquitoes sucked the fever out of one instead of pumping it in!

The bag of twelve tigers was not a bad one. But nine were killed in the first three weeks, and none between April 15 and 30. The unseasonable rains no doubt interfered with sport, making the jungle spring up green and dense, and filling all the waterholes, thus inducing all game to wander, and making it difficult to mark down tigers. With normal weather the bag should no doubt have amounted to eighteen or twenty, and, as it was, two or three tigers which should have been shot were lost by bad luck or bad management.

There is a certain amount of sameness in an account of an expedition of this nature. But it gives some idea of the sport to

be met with in those jungles south of the Wardha river which it was never my fortune to visit again. It may be gathered that sport can only be assured by hard work, and by constant vigilance; and even then one is much at the mercy of stops and beaters. Stops sometimes lose their heads, or misunderstand their directions, however thoroughly these may have been impressed upon them. But when all is said, the sportsman is greatly indebted to these poor men who, for a mere pittance, cheerfully and willingly undertake the great labour of beating in wild and intricate jungle, unarmed and in considerable danger from the wild beasts which they drive from their lairs. And now, more than thirty years after, I recall them and my shikaris and other followers with grateful remembrance and admiration.

THE BLACK AND BROWN BEARS OF EUROPE AND ASIA.

BY

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the British Museum.*)

PART I.

(*With 11 text-figures.*)

EUROPEAN AND ASIATIC REPRESENTATIVES OF THE BROWN BEAR.

(*Ursus arctos.*)

INTRODUCTION.

The Structural characters of Bears.

The Bears or *Ursidæ* are a well-defined family of the Carnivora and are generally so well known that only a brief introductory notice of some of their structural characters is required to explain the meaning of some of the terms employed in the description of the genera and species.

They are large or medium-sized, heavily built, comparatively inactive beasts with erect, rounded ears, relatively small eyes and a well-developed area of naked skin, the *rhinarium*, round the nostrils. The rhinarium varies in different kinds of bears; but typically it is like the corresponding organ in the Canidæ (Wolves, Jackals and Foxes), and divides the upper lip by a narrow strip of skin, the *philtrum*. The lips, however, differ from those of the Canidæ, and indeed from those of all other Carnivora, so far as is known, by being loose and protrusible, owing to their edges in front being free from the gum. Also the tactile vibrissæ which are well-developed on the muzzle, above the eyes and on the cheeks in all predatory Carnivora, are short in the Bears or reduced to practically functionless vestiges. The tail is quite short, serving the purpose merely of an anal operculum; and the anal glands, which are important and of large size in most related Carnivora, like the weasels, badgers and dogs, are absent or negligible in size. The external genitalia are like those of the Canidæ, the prepuce being situated far in advance of the scrotum and the penis provided with a long, stout bone. The attitude of pairing is as in the Canidæ; but the operation is not followed by 'tying' as in that family.

I have compared the Bears more particularly with the Dogs because the two families are known from fossil remains to be nearly related and descended from the same stock. But unquestionably the most marked external difference between them lies in the feet. Dogs have short narrow paws with symmetrically paired or 'artiodactyle' digits of which the 3rd and 4th are considerably longer than

the 2nd and 5th. In the hind foot the heel is raised high off the ground, the area between it and the main plantar pad is covered with hair and the first digit is undeveloped. In the forefoot the first digit, except in the African Hunting Dog (*Lycaon*), is present but is always small, a functionless vestige in fact and is set some little distance from the second and is never in contact with the ground when the animal is standing or on the move. The dog is naturally a predatory hunter and his feet are fashioned for running and leaping and have short, strong claws which grip the ground. The gait is described as 'digitigrade', the body being supported on the plantar pad and the digital pads of four toes. The feet of the Bears are entirely different. They are short and broad, provided with five subequal

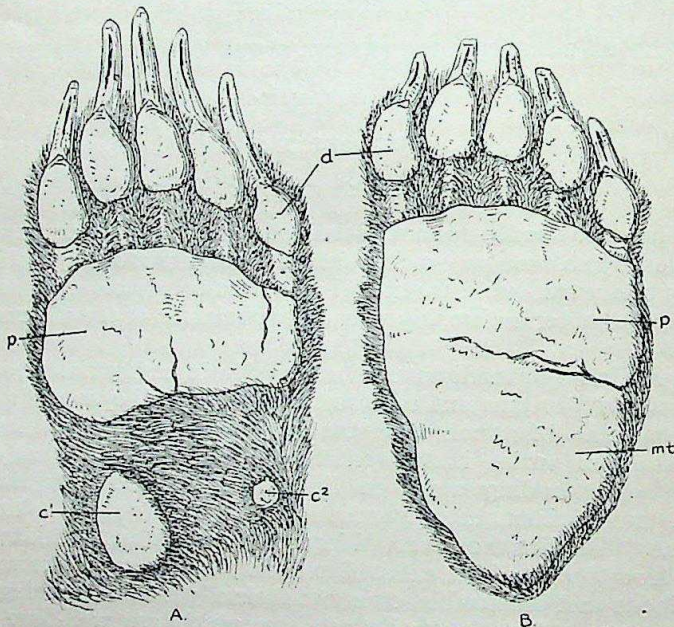


FIG. 1.

- A. Underside of right fore foot of young Red Bear (*Ursus arctos isabellinus*) ; *d* digital pad ; *p* plantar pad ; *c¹* external carpal pad ; *c²* internal carpal pad.
- B. The same of the hind foot. *d* and *p* as in A ; *mt*, metatarsal pad (The hair clipped short to reveal pads.)
- The paws of other genera of Bears will be figured in subsequent parts of this paper.

digits, the pads of which are disposed in a lightly curved line in front of the wide plantar pad, all of them being in contact with the ground. They are armed with long, powerful, curved claws, used for climbing, digging and fighting, the claws of the forepaw, which are more required for those purposes, being about twice as long as those of the hind paw. When walking on all fours a Bear applies the digital and plantar pads of the forefoot to the ground, just as a Dog does. Usually the heel of the hind foot is slightly raised, but it is so close

to the ground that the animal looks as if he were walking 'flat-footed'. When clumsily galloping he appears, at times at least, to use the entire sole of the hind foot for propulsion; and when standing erect in bipedal fashion, an attitude easily assumed on account of the freedom of the knee from the body, the whole sole, back to the heel, is employed for support. For these reasons the gait of a Bear is conventionally described as 'plantigrade'. But that term is somewhat misleading. It is not true of the forefoot and suggests a greater difference than actually exists between the gait of a Bear and of an ordinary digitigrade Carnivore.

The skulls of many youngish bears in dorsal profile are unmistakably like those of dogs, especially domesticated breeds with the cranium vaulted. Structurally the most important difference lies in the external bone of the ear which in the dog has a high, inflated bulla and no appreciable tube to the orifice whereas in the bear the bulla is flat or comparatively slightly inflated and is produced externally in the adult into a long, bony tube with terminal orifice. The teeth, however, of the two animals are profoundly different. Numerically they are the same above and below, the dental formula on each side being $i_3^3, c_1^1, pm_4^4, m_2^3$. The incisors (*i*) and canines (*c*) require no special notice; but the premolars (*pm*) and the molars (*m*), together constituting the *cheek-teeth*, are modelled on totally different lines in compliance with the differences in diet of the animals. The Canidae are predatory flesh-eaters, with typically carnivorous dentition, the fourth premolar above and the first molar below, called the 'carnassials', being the largest teeth of the jaws, set far back at the 'point of greatest mechanical efficiency' and provided with high, compressed, blade-like cusps. The premolars in front of the carnassials, except the first which is small, are tolerably large teeth with compressed sharply-cusped, cutting crowns. The two molars above and below at the back of the jaw are smaller than the carnassials especially in the lower jaw, and comparatively flat crowned, the last of the lower jaw being practically functionless, while that of the upper jaw, although larger and functional, is much smaller than the first molar which precedes it.

The cheek-teeth of the Bears, on the other hand, are essentially adapted for the mastication of hard or fibrous vegetable substances, like roots, grasses, nuts and fruits, although the diet consists also to a great extent of soft fruits, honey, insects and flesh. None of the teeth has cutting blades, and the 'carnassials' are not differentiated either by size or function. The fourth upper premolar, corresponding to the enlarged, trenchant carnassial of the dog or wolf, is a comparatively small tooth with two or three blunt cusps and two roots only; and, as Miller pointed out, differs from that of all other Carnivores, not only in being two-rooted but in being set forwards in the jaw in front of the ante-orbital foramen on the muzzle, well in advance of the 'point of greatest mechanical efficiency.' The first of the three lower molars, representing the lower 'carnassial' of the wolf, is, however, a large, long, broad tooth, with a low cuspidate crown. This and the two molars behind it and the two molars of the upper jaw opposed to them, all having low, crushing, bluntly cuspidate and tubercular crowns, are conspicuously the largest and

principal cheek-teeth, the first three premolars, above and below being small and comparatively functionless, one or more of them

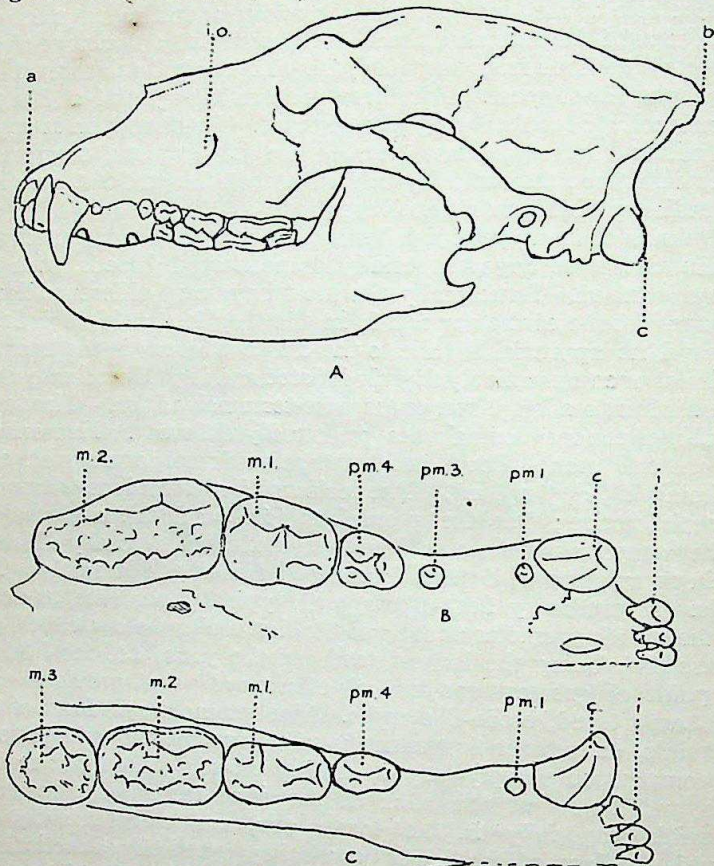


FIG. 2.

- A. Side view of skull of European Brown Bear (*Ursus arctos arctos*) *a* to *b* total length; *a* to *c* condylo-basal length; *i.o.* infra-orbital foramen.
 B. Teeth of right side of upper jaw of Red Bear (*U. a. isabellinus*). *i* incisors; *c* canine; *pm* premolars; *m* molars.
 C. Teeth of left side of lower jaw of the same. Lettering as in B.

being frequently shed before old age supervenes. In the particulars mentioned above, the dentition of the Bears is absolutely distinctive of the family.

In addition to the Bears mentioned in this paper there are only two well-marked existing genera of the family, namely the Polar bear of the arctic and the so-called Spectacled bear (*Tremarctos ornatus*) of South America. Blanford, however, in his volume on *The Mammals of British India* (p. 205) assigns to the Ursidae a beast, inhabiting Moupin, which he cites as *Ailuropus melanoleucus*. This animal, now known as *Ailuropoda melanoleuca*, is the so-called Parti-coloured Bear or Giant Panda. The latter title is decidedly preferable because the animal, although superficially resembling a small bear in size and shape, differs so profoundly in dentition and other

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structural features that it must be excluded from the family and associated rather with the true Panda, its resemblance to the bears being a case of adaptive convergence.

THE DISTINGUISHING CHARACTERS AND DISTRIBUTION OF THE
EUROPEAN AND ASIATIC BLACK AND BROWN BEARS.

In his volume on *The Mammals of British India*, Blanford referred the four species of Bears inhabiting that area to two genera: *Ursus*, comprising the Brown Bear (*U. arctus* or *arctos*), the Himalayan Black Bear (*U. torquatus* or *thibetanus*, as it is now called) and the Malay Bear (*U. malayanus*), and *Melursus*, comprising the Sloth Bear (*M. ursinus*). In this he followed the example of most of his predecessors; and, like them, he attached great importance to the absence of the two median upper incisor teeth in differentiating *Melursus* from *Ursus*. This classification is, however, open to the criticism that the evidence supplied by the skull and forefeet shows

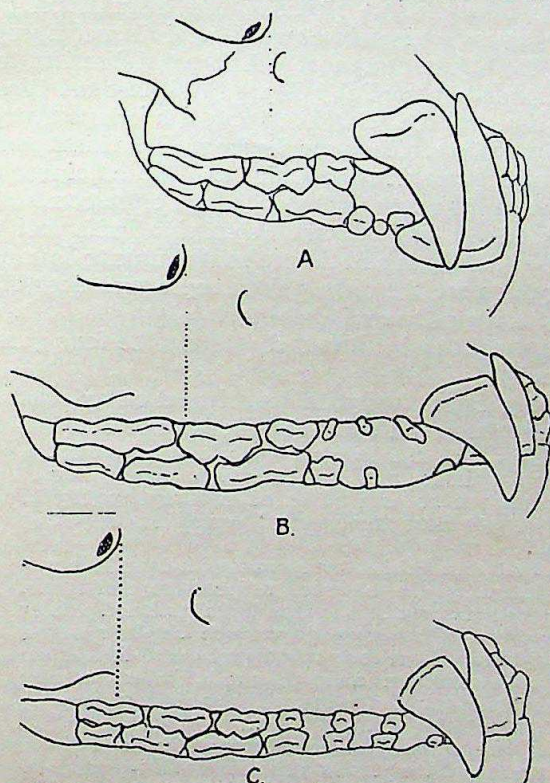


FIG. 3.

- A. Jaws of the Malayan Bear (*Helarctos malayanus*) showing the short muzzle and the enormous canines with consequent crowding of the premolars.
- B. The same of the Himalayan Black Bear (*Selenarctos thibetanus*) with longer muzzle and nearly complete dentition.
- C. The same of the Sloth Bear (*Melursus ursinus*) with still longer muzzle and complete, more primitive dentition. (The dotted line is a tangent from the front edge of the orbit to the upper molar teeth.)

that the kinship between the Sloth Bear (*Melursus ursinus*) and the Brown Bear (*Ursus arctos*) is closer than the kinship between the latter and the Malay Bear (*Ursus malayanus*). Horsfield, indeed, perceiving that the characters of the Malay Bear were of generic importance, had as early as 1824 separated it from *Ursus* as *Helarctos*. These distinctions did not appeal to Blanford; but they are deep-seated; and the genus *Helarctos* is admitted at the present time by every zoologist familiar with the group. The Himalayan Black Bear, as it is somewhat inappropriately called, also receives deserved generic status under the name *Selenarctos*, assigned to it in 1901 by Heude, who distinguished it from *Ursus* by the already known differences between the two in cranial characters. Being unacquainted with Heude's work I proposed the name *Arcticonus* for the same bear in 1917, separating it from *Ursus* by a well-marked difference in the structure of the forepaw which I pointed out in 1914.

Thus each of the four species described in Blanford's volume is the representative of a distinct genus. The distribution of the four genera is interesting. *Ursus* is, or was, found all over Europe, temperate Asia and North America, mostly in forested districts to the south of the area occupied by the Polar Bear (*Thalarctos maritimus*). Along its southern limit in the Old World it just overlaps everywhere the range of *Selenarctos* which extends from Baluchistan through the Himalayas and thence through China and the adjoining continental islands at least as far north as Amurland. To the south of the range of *Selenarctos* occurs *Melursus* in Peninsular India and Ceylon and *Helarctos* in Burma, Siam and thence southwards to Java and Borneo. These two genera are the only Asiatic representatives of the family which are exclusively Oriental in range.

By cranial, dental and external characters the four genera may be readily defined.

The following is an analytical key, based on external features by which properly preserved skins may be at once determined:—

- a. Carpal area of the forefoot with a single, cordate external (ulnar) pad and at most a small internal (radial) pad or area of naked skin representing it. Digital pads more closely united, sometimes completely fused.
 - b. Carpal area thickly overgrown with long hair surrounding the external pad and concealing the internal; area between the digital pads and plantar pad on both feet overgrown with long hair arising typically from four interdigital mats. Rhinarium with philtrum and without valvular nostrils; muzzle hairy to the lips which are only moderately protrusible. ... *Ursus*.
 - b¹. Carpal area and the area between the fused digital pads and the plantar pad naked; rhinarium without philtrum and with valvular nostrils; lips almost naked and highly protrusible. ... *Melursus*.
- a¹. Carpal area of forefoot occupied by a single large piriform pad, with ulnar and radial elements obscurely indicated, as wide as the plantar pad and nearly or quite as long externally.
 - c. Ears, as in *Ursus* and *Melursus*, long expanded, basally tubular and mobile and strengthened by vertical cartilaginous ridges; rhinarium and lips nearly as in *Ursus*. ... *Selenarctos*.

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- c¹. Ears short, not expanded, not tubular basally, hardly mobile and without vertical cartilaginous ridges; rhinarium and lips in a measure adaptively foreshadowing those of *Melursus* ... *Helarctos*.

Key to the genera based upon adult skulls:—

- a. The whole skull short and broad, its mastoid width equal to the length of the palate + the mesopterygoid fossa, or longer; tympanic bulla convex, its width with the auditory tube about equal to the length of the upper cheek-teeth; these teeth short but the canines and incisors relatively very large, the basal length of the upper canine at least as long as the last upper molar ... *Helarctos*.
- b. Skull longer relatively to its width, its mastoid width seldom exceeding the palate; tympanic bulla flattened, its width with the auditory tube much less than the area of the upper cheek-teeth; canines and incisors relatively smaller, basal length of upper canine, except in *Melursus*, less than length of last upper molar.
- a¹. Median upper incisors present; palate flat or only slightly concave between the cheek-teeth, which are comparatively large, so that the length of its post-dental portion is much less than that of the last three upper cheek-teeth; anterior premolars reduced; last upper molar larger than the first.
- c. Jaws short in comparison with the cranium proper; cheek-teeth less strongly cusped and set farther back so that the anterior edge of the last upper molar is not in front of the antero-inferior edge of the orbit ... *Selenarctos*.
- c¹. Jaws longer in comparison with the cranium; cheek-teeth more strongly cusped and set more forward so that the anterior edge of the last upper molar is in front of the antero-inferior edge of the orbit ... *Ursus*.
- b¹. Median upper incisors absent; palate markedly vaulted between the cheek-teeth, which are set forwards and reduced in size, so that the length of the post-dental portion of the palate is not less than the length of the last three upper cheek-teeth; anterior premolars less reduced; last upper molar subequal to first ... *Melursus*.

Note on the Analytical Keys. The key based upon external features has the advantage of applying to cubs as well as to adult and old bears. This is not true of the key based upon cranial features which alter greatly with age and seem to continue to vary throughout the life of the individual. The skulls of cubs of all species are much alike apart from minor differences; but there is no difficulty in distinguishing the skulls of adults. *Helarctos* and *Melursus* show exceedingly well-marked features; but *Selenarctos* and *Ursus* are not so sharply defined. As in the structure of the paws, so too in the skull and teeth, *Selenarctos* unmistakably comes nearest to *Helarctos* and *Ursus* to *Melursus*.

Under the headings 'a' and 'b' of the second table the proportion between the mastoid width and the median palatal length is used as a character. The difference is best marked in *Helarctos*, where the mastoid width greatly exceeds the palate, and in *Melursus* where it is much less. In *Selenarctos* and *Ursus* the dimensions are on the average tolerably subequal; but in both genera the mastoid width may surpass the palate. In the case of *Selenarctos* this is due to the shortness of the palate accompanying the shorter jaws of that genus. In the case of *Ursus* it is due to excessive development of the mastoids which occurs sometimes in very old animals.

GENUS *URSUS*, Linn.

Ursus, Linn., *Syst. Nat.*, ed. 10, p. 47, 1758 (in part); Miller, *Cat. Mamm. Western Europe*, p. 285, 1912; Pocock, *Proc. Zool. Soc.*, 1914, p. 940.

Myrmarcos, Gray, *Proc. Zool. Soc.*, 1865, p. 694.

Ursarcos + *Melanarcos*, Heude, *Mém. Soc. Hist. Nat. Chin.*, IV, pt. I, p. 18, 1898.

Mylarcos, Lönnberg, *Proc. Zool. Soc.*, 1923, p. 85.

Spelæus (Goldfuss), Sowerby, *Journ. Mamm.* I, pp. 224-232, 1920

It is needless to repeat here the generic diagnosis of *Ursus* given in the tables printed above.

Notes on the synonymy. In Miller's Catalogue, above quoted, he cited *Myrmarcos* and *Ursarcos* as synonyms of *Ursus* but omitted *Melanarcos* Heude proposed for the black Manchurian bear named *cavilrons*. This is dealt with below under the race of Brown Bear described as *U. arctos lasiotus*. The two last names on the list were

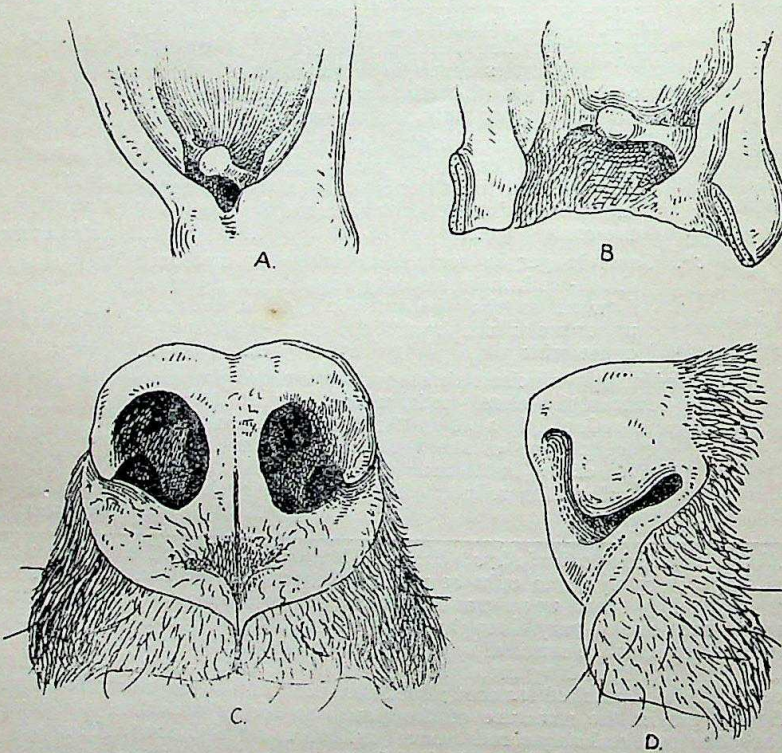


FIG. 4.

- A. Base of ear of European Brown Bear (*U. a. arctos*) with hair removed.
 - B. The same cut open to show the ridger.
 - C. The rhinarium, or nose, of Grizzly Bear (*U. a. ferox*) from Montana. Front view.
 - D. The same from the side.
- The ear and nose of other genera of bears will be figured in subsequent parts of this paper.

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introduced since the publication of the Catalogue and reasons for their dismissal must be given.

Mylarctos was proposed by Lönnberg for *Ursus pruinosus*, Blyth, because he considered it differed from *Ursus*, typified by *arctos*, in the following particulars:—

1. (a) The digital pads of both fore and hind feet are fused nearly to their distal ends so that the hairs from the sides of the toes do not project downwards between them.
- (b) The hairs between the digital and plantar pads are arranged in four interdigital patches or mats, leaving a smooth, hairless strip of skin passing from the digital pads to the plantar pads.
2. The teeth, especially the molars, are relatively and actually much larger. This is demonstrated by several dimensions taken from the two examples of *pruinosus* available to him for examination and from others recorded by Leche, as compared with dimensions of Swedish bears and of one skull of the Mongolian bear (*lasiotus*).

My reasons for rejecting *Mylarctos* are as follows:—

1. (a) An example of *pruinosus*, in the British Museum, from the borders of Tibet and China (*Capt. Neill Malcolm*) has the digital pads separated precisely as in typical *Ursus arctos*.
- (b) An example of *Ursus arctos* has the hairs on the space between the digital and plantar pads disposed in patches or mats exactly as described and figured by Lönnberg as distinctive of *Mylarctos*.
2. The skull of an example of *pruinosus*, from N.-E. Lhasa, of approximately the same age as Lönnberg's young specimen from S.-W. Kansu, has relatively and actually much smaller teeth, the last lower molar being visible practically in its entirety in profile view and unconcealed in its posterior portion by the ascending process of the mandible. Moreover, the tables of tooth-measurements published below show complete intergradation in size between the teeth of *pruinosus* and those of other races of *Ursus*, notably *U. arctos lasiotas* and *yesoensis*.

In 1920 A. de C. Sowerby attempted a revision of the Bears of this group inhabiting Eastern Asia, and admitted 12 'species' referable to 2 genera, *Ursus* and *Spelæus*, distinguished by the shape of the forehead. Unfortunately, the author's acquaintance with Bears and the material at his disposal were alike small. The shape of the skull varies profoundly with age, sex and in adult individuals of both sexes from the same district and as a character is not even of specific value; and as regards the 12 'species', Sowerby fell into the fundamental fallacy of assuming that Bears from the same locality are alike in colour and cranial features. The coat, in colour and other characters, varies greatly according to the season and to a less extent

irrespective of season. These points will be dealt with under the various headings.

DESCRIPTION OF THE RACES OF *Ursus arctos*.

Ursus arctos, Linn.

Ursus arctos, Linn., *Syst. Nat.*, ed. 10, I, p. 47, 1758, and of subsequent authors including Miller, *Cat. Mamm. Western Europe*, pp. 285-297, 1912.

Distribution. Europe, North and Central Asia, N. America.

Following Lydekker, I regard all the bears, generally described as 'browns' and 'grizzlies', inhabiting Europe, Asia and North America, as members of this species, some of the technically described forms representing subspecies or local races.

THE EUROPEAN BROWN BEAR.

Ursus arctos arctos, Linn.

Locality of Type: Sweden.

Distribution: Europe; eastern range into Asia unknown.

In Miller's volume, above quoted, more than a page is devoted to the names given by authors to supposed species, races or varieties of the European Brown Bear. It is needless to repeat all the names with bibliographical references, but the following may be quoted to indicate the seasonal, local or individual variations in colour, which were regarded as of systematic significance. Some of the names, too, were based on differences in skulls, due to age or sex.

Niger, Gmel., N. Europe; *major*, Nilss., S. Scandinavia; *minor*, Nilss., N. Scandinavia; *brunneus*, *annulatus*, *argenteus*, *myrmecophagus* (= *formicarius*), Billb., N. Scandinavia; *norvegicus*, Fisch., *aureus*, Fitz., *eversmanni*, Gray, Norway; *polonicus*, Gray, Poland; *badius*, Schr., Bohemia; *fuscus*, Gmel., *rufus*, Borkh., *alpinus*, Fisch.; Alps; *pyrenaicus*, Fisch., *pyrenaëus*, F. Cuv., Asturias, Spain. The bear of Barbary has been named *crowtheri*.

Considering the wide range of this bear from north to south in Europe, it is possible that more than one local race has been developed. But the available material is insufficient to establish this conclusion; and since the species has been killed out in all the settled districts and is apparently very rare even where it still lingers, it is improbable that skins and skulls will ever be procured to demonstrate whether the Barbary, Pyrenean, Alpine or Bohemian brown bears differ from the typical Scandinavian bear or not. Cabrera, however, claimed that the Spanish bear differs from the typical Swedish race in its black legs and the different proportions between the length of the skull and the zygomatic width. (*Fauna Iberica: Mamm.*, p. 152, 1914.) The last-mentioned character, however, is too variable with age to be trusted and the legs are deep brownish black in the skin described below from Lake Ladoga, which from its distribution should be typical *U. a. arctos*.

Comparatively recently, Altobello recorded the brown bear from Abruzzo and Molise in Italy, naming it *Ursus arctos marsicanus*

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(*Fauna Abruzzo e Molise; Mamm.*, p. 15, 1921; *Rend. Un. Zool.*, p. 32, fig. 1924; *Ann. Ist. Technic.*, pp. 15-16, fig. 16, 1926). He distinguished it from the typical form because a skull of it differed from the unlocalised skull *U. a. arclos*, selected for illustration by Miller, in having a shorter sagittal crest. But this character, being in my opinion, a matter of age or individual development, has no systematic value.

Of European bears referred to the typical race, there are only four in the British Museum.

1. A mounted specimen from Sweden (Earl of Selkirk, 1840), in new winter coat. General colour uniformly pale brown, the tips of the hairs dull buff with a greyish glint in certain lights; the basal portions of the hairs and the underwool dark brown but this tint only showing when the coat is artificially disarranged. Legs deep brown. No trace of a white collar. Claws black.
The mounted specimen is $3\frac{1}{2}$ ft. at the shoulder.
2. Flat skin from Bihar, Hungary in new winter coat. General colour uniformly drab brown, the tips of the hairs showing up vividly as whitish buff under reflected light, especially on the head, neck and fore quarters. But on the back the pallid tips of the hairs are less extensive and not so pale, being scarcely in evidence on the shoulder-mat which is the same dark brown hue as the basal parts of the hairs elsewhere. The underwool greyish brown. The head is greyish buff; the legs dark brown and glistening. A patch of wholly white hair on the side of the neck showing trace of a collar. Claws black. The hair on the back is about $3\frac{1}{2}$ inches, on the flanks $4\frac{1}{2}$ and on the mat and neck 5.
3. Skin from the Engadine in old thick and tufted winter coat. General colour very grey, but mottled where the hair is parted by tufting. The basal portion of the hairs darker than in the preceding specimens, almost blackish brown, and more strongly contrasted with the tips which are more extensively pallid and decidedly greyer, apparently bleached. The underwool greyish brown. Legs darker than in preceding specimens, the fore legs almost blackish brown. The ventral surface pale brown, the hairs with grizzled tips. Claws not so black, tinged with pale horn colour.
4. Lake Ladoga (Ivor Montagu, B. M. No. 29-5-24-1). Skin of a subadult female in summer coat, with little, if any, underwool. Head golden brown. General colour greyish brown, mottled where the hair is disarranged showing the dark brown bases of the hairs on the back and the paler brown bases on the flanks, the tint variable with the fall of the light; the rump noticeably reddish brown. No white collar. Legs rich blackish brown.

Skulls. In the following table are given the principal measurements of the skulls in the British Museum, those of the cranium being given in English inches, those of the teeth in millimetres. The legends of the figures of the skull explain the terms applied to the

different regions. It may be added that since the total length of the skull depends upon the development of the occipital crest, a muscular ridge subject to variation, the condylo-basal length is a better criterion of size. These remarks apply to all the tables of cranial dimensions published in this paper. Also, it must be explained, the collective measurements of the last 3 upper cheek teeth ($pm^4 + m^1 + m^2$) and of the last 4 lower cheek teeth ($pm_4 + m_1 + m_2 + m_3$) varies in accordance with the curvature of the tooth-row. In two skulls, for instance, in which the teeth are individually of the same length respectively, the series, if straight in one skull, will be a little longer than in another in which it is curved.

Locality and sex		Skull in English inches. ¹						Upper teeth		Lower teeth	
		Total length	Cond. bas. length	Zygom. width	Mastoid width	Int. orb. width	Max. width	Last 3 teeth	Last tooth	Last 4 teeth	Penult tooth
Sweden, old	♂	14.8	13.8	9.9	7	3.4	3.2	65	31 × 17	75	22 × 13
Russia, subad	♂	14.5	13.5	7.6	6.2+	3-	...	72	37 × 20	...	25 × 16
Sweden, ad.	♂	13.8	12.9	8.4	6.3	3	3	65	30 × 16	75	23 × 13
„ young (?)	♂	...	...	...	...	...	...	71	35 × 17	81	24 × 15
Olonetz, Russia, old	♂	12.7	12.1	8	6.2	3	...	66	30 × 17	75	22 × 13
Norway, young	♂	12.6	11.9	7+	5+	2.8	2.8	...	34 × 19	...	25 × 15
Lake Ladoga, subad	♀	12.1	11.7	6.7	5.1	2.6	2.5	66	31 × 16	75	23 × 13
Norway,	♀	11.8	11	6.3	4.6	2.1+	...	63	29 × 16	68	22 × 12
Engadine,	♀	...	10.2	6.2	4.6	2.4	...	61	29 × 17	68	21 × 12
Transylvania ad.	♀	12.3	11.7	7.4	5.4	...	2.8	69	34 × 16	75	24 × 14
„ ad.	♀	12.1	11.5	6.9	5	2.6	2.8	68	34 × 17	77	23 × 15
„ young		11.9	11.3	6.6	5	2.3	2.5	65	31 × 18	75	23 × 14

¹ The measurements are taken as follows:—Total length from the edge of the muzzle above the incisor teeth to the end of the sagittal crest; condylo-basal length from the same point to the posterior edge of the occipital condyle; zygomatic width across the zygomatic arches; mastoid width across the mastoid processes; inter-orbital width, the narrowest point between the orbits; maxillary width, the width of the muzzle just above the socket of the canine teeth; the last 3 upper and the last 4 lower teeth, their total length as situated in the jaw; the last upper tooth and the penultimate lower tooth, their greatest length and width.

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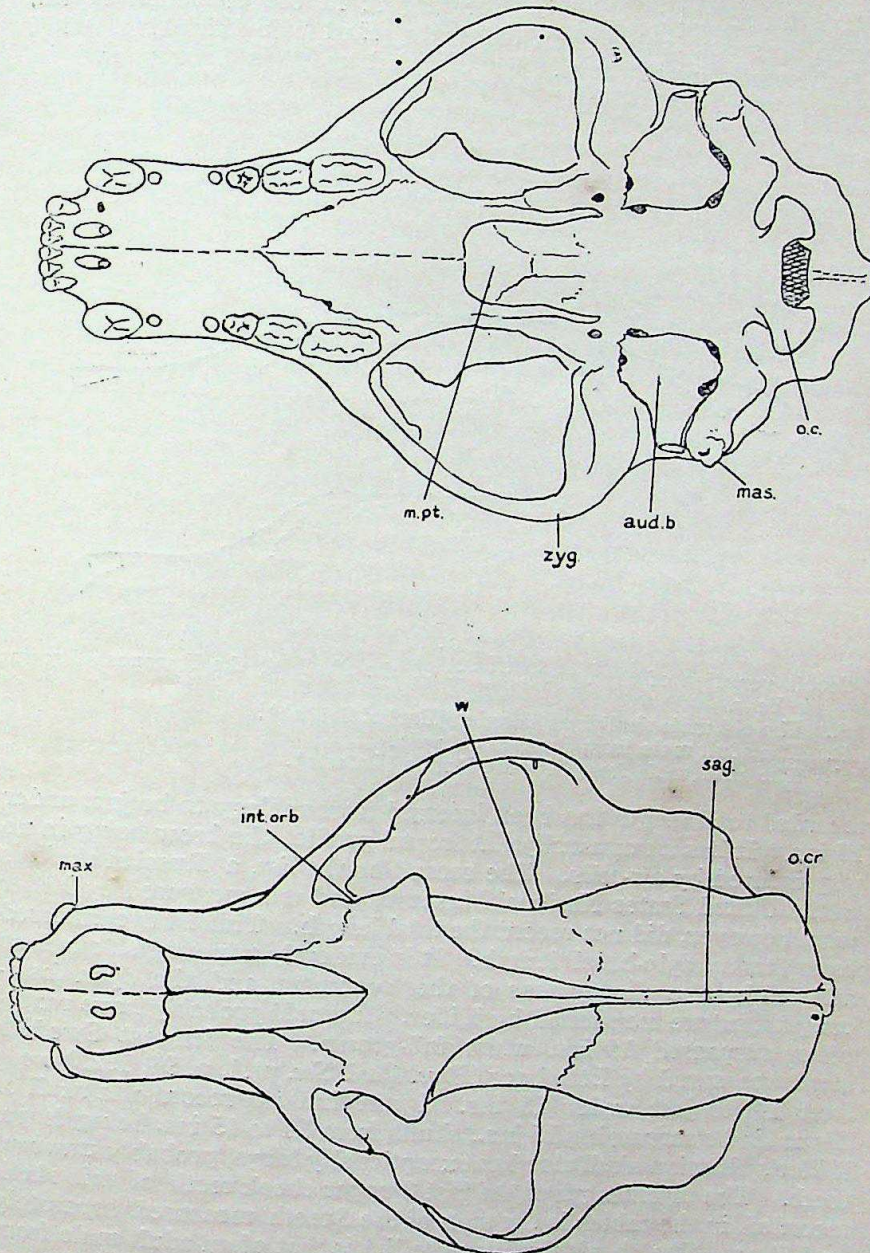


FIG. 5.

Upper fig. Lower view of skull of European Brown Bear (after Miller). *m.pt.* mesopterygoid fossa; *zyg.* zygomatic arch; and *v* auditory bulla; *mas.* mastoid process; *o.c.* occipital condyle.

Lower fig. Upper view of the same. *max.* maxilla; *int. orb.* inter-orbital area; *w.* waist; *sag.* sagittal crest; *o.cr.* occipital crest. (These figures and fig. 2 show the points where measurements are taken.)

The first skull on this list, the largest in the collection of the British Museum, is that of an old male (Earl of Selkirk, No. 218a), with the teeth much worn. Its occipital crest is broken and its

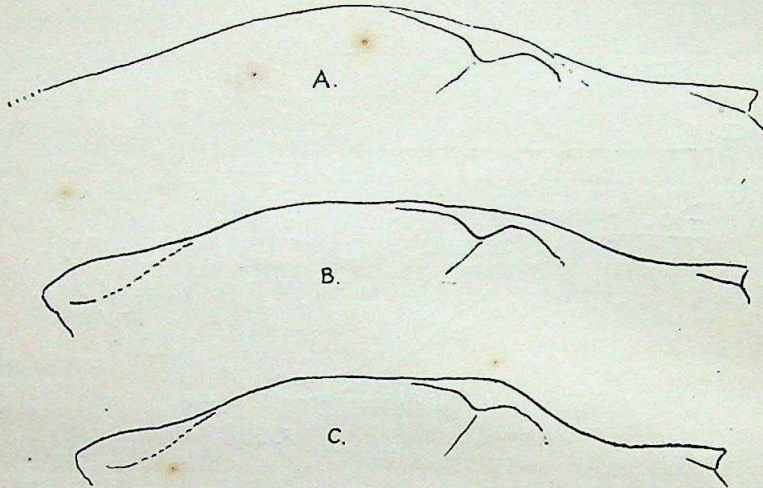


FIG. 6.

Profile variation of the upper surface of the skull of the European Brown Bear.

- A. The old male skull from Sweden (Earl of Selkirk).
- B. The adult male from Sweden (Lloyd).
- C. The adult male from Olonetz, Russia (Lataste).

recorded total length has been inferred from analogy to be just under 15 ins. It has an unusually flat frontal profile, the brow being in no way inflated by air-cells. The second on the list, a Russian skull, is in the United States National Museum, and was measured by Miller who, however, did not record the total length. This I have inferred from the condylo-basal length. It is evidently a youngish skull as attested by the narrowness of the zygomata and the open basi-occipital suture mentioned by Miller. It would probably have reached or surpassed 15 ins. when full-grown. The longest Swedish skulls measured by Lönnberg (*Proc. Zool. Soc.* pt. 1, p. 94, 1923) were from 14½ to just under 15 ins. I can find no record of a skull of *Ursus arctos* surpassing 15 ins., skulls from 14 to 15 ins. being large. Miller's Russian skull also has exceptionally large, probably unworn, teeth. The total length of the last 3 upper cheek teeth of this skull, recorded in the tables is the sum of the 3 teeth measured separately by Miller. The third skull on the list is that of an adult male from Sweden (Lloyd, No. 62. 3. 29. 7). It is considerably shorter and narrower than the Earl of Selkirk's, but wider than Miller's Russian skull, although not so long, and the teeth are much smaller; but the fourth, a young, probably male, specimen, with the same history (No. 62. 3. 29. 8), has considerably larger teeth, nearly as large as in the Russian skull. The fifth skull from the Province of Olonetz (Lataste Coll., No. 19. 7. 7. 3609), although unsexed and comparatively small, I regard as a male on account of its shape. It is

noticeably 'high-browed' from the inflation of the frontals between the post-orbital processes, with a marked concavity at the base of the muzzle. It differs most strikingly in this particular and in size from the Earl of Selkirk's Swedish skull; but the Swedish skull, No. 3 on the list, is almost exactly intermediate between the two in both these particulars. The sixth skull from Telemarken, Norway, preserved in the Royal College of Surgeons Museum, is not mature, the cranial sutures being unfused and the teeth, which are large, unworn.

The skulls of adult females I have seen are smaller, between 12 and 12½ ins. long, and narrower everywhere. They also show no inflation of the frontals and may be described as low-browed, the dorsal profile sloping tolerably evenly from the highest point near the middle of the crown to the end of the muzzle. The teeth, however, are approximately as large as in the males. I have seen no quite adult female skulls from Scandinavia; but there is one very nearly full-grown from Lake Ladoga in Russia (Ivor Montagu, No. 29. 5. 24.1). A series of three from Transylvania does not differ from it in any way suggesting that they may represent a distinct local race.

From an examination of these and other skulls in the British Museum I can find no reasons for the adoption, as indicating subspecies, of any of the names that have been proposed for the European bears. The individual variation in the size and shape of the cranium and of the teeth in specimens from the same or nearly adjoining districts is very striking and shows the untrustworthiness of the characters that have been used by systematists for the differentiation of the European bears into species and local races.¹

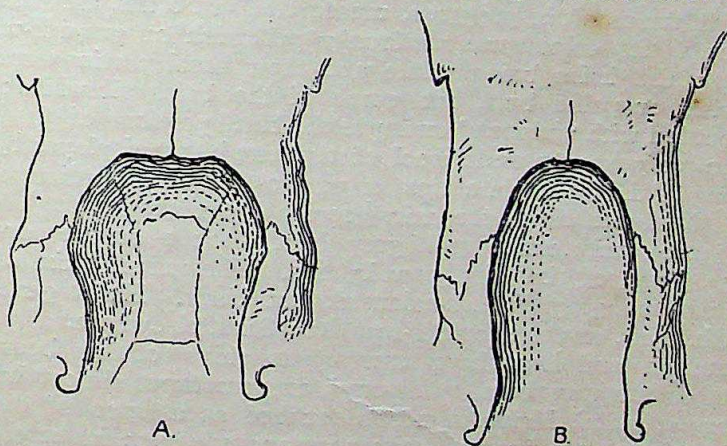


FIG. 7.

Variation in the shape of the mesopterygoid fossa in the European Brown Bear.

- A. A youngish specimen from Bihar, Hungary.
- B. An adult specimen from Transylvania.

¹ Examination of the skulls of the bears of the *Ursus arctos* group enumerated in this paper from Europe and Asia forces me to reject, without hesitation, the conclusion that the closely related bears, 'grizzlies' and others, of North America are divisible into all the host of species and subspecies that have been established on cranial and dental characters.

Other characters are also subject to variation. As an instance I may cite the mesopterygoid fossa which may be either long and narrow or short and wide, as shown in the subjoined sketch of this region in skulls from Hungary and Transylvania, districts too near and too similar in physical features to permit, in my opinion, the conclusion that two different kinds of bears are concerned.

In conclusion I may repeat that the material in the British Museum completely corroborates the statements of Miller and Lönnberg regarding the variability of the skulls of the typical European race of *Ursus arctos*. Lönnberg, indeed, criticising Sowerby's views on this point, wrote:—'We have . . . from the same tract of southern Lapland skulls with a straight profile and others with the profile just as concave as Heude's figure of *cavifrons*.'

THE SYRIAN BEAR.

Ursus arctos syriacus, Hempr. and Ehrenb.

Ursus syriacus, Hemprich and Ehrenberg, *Symb. Phys.* I (unpaged) pl. 1, 1828. Quoted by most subsequent authors but apparently not accurately known to them.

Ursus schmitzi, Matschie, *SB. Ges. Nat. Fr. Berlin*, 1917, p. 33.

Locality of type of *syriacus*: near the village of Bischerre, Mt. Makmel, Lebanon.

" " " *schmitzi*: Mt. Hermon.

Hemprich and Ehrenberg described this bear as smaller than *U. arctos arctos* and paler in colour. The typical specimen, killed in July with the moult in progress, measured 3 ft. 8 ins. and was not full-grown. Its colour was uniformly yellowish or greyish-white, the tips of the hairs being white and their basal portions mostly yellowish or pallid buff, but some of the hairs all white; the coat mottled with 'fulvous' owing to the basal portions of the hairs and the very scanty underwool of that tint being displayed by the shedding of the dead white tips in patches or by their disarrangement. Near the claws the hairs greyish or 'palely fuscous'. The claws varied with white and grey bands, those of the forepaw 1.9 ins. long, of the hind paw 1.3 ins. The naked skin of the nose and lips greyish flesh-coloured, not black. Hairs generally shortish, 4 ins. on the shoulder-mat, 2 to 3 ins. elsewhere.

Hemprich and Ehrenberg saw other skins of this bear and said its colour may be all 'fulvous' or sometimes almost brown.

Ursus schmitzi, Matschie, was described as a 'species' distinct from *syriacus* because of certain supposed but, in any case valueless differences in colour; and since Mt. Hermon is only a short distance to the south of Mt. Lebanon, there are not, in my opinion, any good reasons for considering that *schmitzi* is even racially distinct from *syriacus*.

A number of names have been given, principally by Russian authors, to so-called races of bears from the Caucasus and Transcaucasia. These were based partly upon colour, partly upon cranial variations and size of teeth. The results reached are hopelessly at variance and, in my opinion, eminently unsound; but owing to the

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scanty material at my disposal I am unable to disentangle the confusion. The only contribution to the question I can make is an epitome of the conclusions with my reasons for dissenting from them resting upon such information as I possess regarding bears' skulls in general and upon the material at my disposal from Caucasia, Asia Minor and Syria in particular

Ursus arctos var. *meridionalis*, Middendorff, *Verhandl. Russ. Kais. Mineral. Gesellschaft.* 1851, p. 80.

The name *meridionalis* was apparently used by Middendorff originally as a comprehensive title for three southern brown bears, *pyrenaicus*, *syriacus* and *isabellinus*; but since he expressly mentioned the Caucasus as its locality, probably because he had a skull or skulls from that part of Russia, and since subsequent authors have restricted the name to Caucasian bears, I see no reason to interfere with that application of it.

Middendorff regarded this bear as distinct from the European variety, which he called *normalis*, because the smallest skulls of it are one-twelfth shorter than those of the typical form. He was concerned with cranial characters only and gave no information about the colour of *meridionalis*.

Radde (*Fauna und Flora des Caspi-Gebietes*, p. 6, 1886) wrote of *meridionalis* as occurring not only in the district of Talysch on the south-west coast of the Caspian but generally throughout Transcaucasia. The colour is almost entirely pale, varying from light dirty yellowish grey to fawn and reddish grey-brown, intergrading more or less with that of *syriacus*. In size the bears vary considerably.

It is important to note that Radde definitely applied the name *meridionalis* to the pale bear of Transcaucasia which approaches *syriacus*. Since he was apparently the first author to describe the colour of this race, I abide by his decision.

Further evidence of the generally light hue of Caucasian bears was supplied by Grevé (*Nov. Act. Acad. Leop.* 63, p. 225, 1895), who wrote of pale specimens from that region exhibited in the Zoological Gardens, Moscow. This author, like some of his predecessors and successors, seems to have thought that two species of the Brown Bear may live separate lives, without interbreeding, in the same district. At all events he assigned the bears of Europe and northern Asia to one 'brown' species *Ursus arctos*, including *meridionalis* from the Caucasus; and the bears of south-western Asia to another 'Grey' species *Ursus syriacus*, which inhabits the Caucasus, Transcaucasia, Asia Minor, Palestine and Mount Elburz and Shiraz in Persia. But in view of Radde's earlier application of *meridionalis* to the pale Caucasian bear, Grevé's ascription of it to the 'brown' bear cannot be entertained.

Amongst the synonyms of *syriacus* Grevé cited '*caucasicus* Schrank [Schrenck]', a name which seems to have no status. He said that Gray regarded Middendorff's *meridionalis* and Schrank's (*sic*) *caucasicus* as races of *arctos*. Gray, it is true, admitted *meridionalis* as a 'subvariety' of *arctos* (*Proc. Zool. Soc.* 1864, p. 662; *Cat. Carn. Brit. Mus.*, p. 220, 1867); but he did not mention *caucasicus*. Trouessart, misled apparently by Grevé, also quoted '*caucasicus*, Schrenck' (*Cat. Mam*, I, p. 241, 1897); but he gave no bibliographical reference

to it. I too have failed to trace it in Schrenck's essay on Asiatic bears (*Reise Amurland*, I; *Saug.*, p. 7, 1858.)

As will be shown below, the name *caucasicus* was later resuscitated by Smirnov without reference to its previous introduction by Grevé.

Between 1896 and 1914 Satunin discussed the bears of the Caucasian area with various changes of opinion. His first record was the occurrence of three races, namely typical *Ursus arctos*, *U. arctos meridionalis* and *U. arctos syriacus*. He gave the name *meridionalis* to 'very pale coloured' bears of Transcaucasia; but apparently included *syriacus* on the authority of Hemprich and Ehrenberg, whose diagnosis he abridged, giving its distribution as Transcaucasia from the Black to the Caspian Seas (*Zool. Jahrb. Syst.* 9, p. 292, 1896). Subsequently he united these two under the name *meridionalis* which he described as 'for the most part very pale', and excluded *syriacus* from the Transcaucasian fauna (*Mitth. Kauk. Mus.*, 2, p. 287, 1905). Later in the same volume (p. 374) he wrote: 'the dark Transkaukasian and Persian bears I consider to be *meridionalis*.' This change in the application of the name *meridionalis* was, in my opinion, quite unjustifiable in view of Radde's ascription of the name *meridionalis* to the pale Transcaucasian bear, as mentioned above.

Satunin's next move in 1913 was to introduce the name *lasistanicus* for the pale Transcaucasian bears (see *Mitth. Kauk. Mus.*, 8, p. 5, 1914). And in his last paper (*Conspect. Mamm. Imp. Ross.* 1914, pp. 93-94), the two names *meridionalis* and *lasistanicus* appear to symbolise the bears of this district of Asia. But *lasistanicus* falls as a synonym of *meridionalis* as defined by Radde.

The truth no doubt is that Caucasasia is a transitional zone, so far at least as the colour of its bears is concerned, between typical *U. arctos arctos* and *U. a. syriacus*. Some years ago the Zoological Gardens received from a donor, who brought them from the 'Caucasus', two young bears of the same age and size and very likely cubs of the same litter. One was darkish brown and indistinguishable from living specimens I have seen from northern Russia; the other was pale tawny like so-called 'Syrian' bears.

Satunin's conclusions were based upon a study of skins. His successor, Smirnov (*Bull. Mus. Cauc.*, 12, pp. 109-133, 1919), worked at the skulls with the result that he came to different conclusions and increased the number of named forms even to the extent of introducing a quadrinomial title to express one case of cranial variation. He admitted the following forms:—

- (a) *U. arctos arctos*, from western Ciscaucasia.
- (b) *U. a. var. caucasicus*, nov. (= *U. a. meridionalis*, Midd. + *U. a. arctos*, Sat.), from the main chain of the Caucasus and Borjom.
- (c) *U. a. arctos natio* [*sic*] *dinniki* nov., from Caucasus Minor.
- (d) *U. a. meridionalis*, Midd., from the median region of south Europe, northern slopes of the main chain of the Caucasus, western and south-eastern Transcaucasia, N. Persia.
- (e) *U. a. lasistanicus* (= *syriacus*, Sat.), from S.-W. Transcaucasia, where it is most numerous, Lazistan and probably almost everywhere in the habitat of *meridionalis*...

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It is needless to reproduce the description of these supposedly distinct forms of bears. They are based almost wholly upon differences in the shapes of the skulls and the size of the teeth. Smirnov fortunately published a series of photographs of the skulls of all of them, except *lasistanicus*. These photographs, although small and obscure, are sufficient to show the main features on which he relied. The evidence that these skulls represent geographical or environmental races amounts, in my opinion, to very little. From what I have seen of the skulls of bears, I should say that they represent stages of development that could be closely paralleled by almost any good series of skulls of *Ursus arctos* from any country, the differences between them being due partly to differences of age, partly to use, greater or less, of the cranial muscles, partly to innate individual variation. The skull assigned to *U. a. arctos* resembles tolerably closely the adult male Swedish skull (Lloyd No. 62.3.29.7) described above, but is very different from the flat-browed Swedish skull presented by Lord Selkirk (No. 218a) and from the high-browed skull from Olonetz. The one labelled *dinniki* is like the one labelled *U. a. arctos* but is not quite so hollowed in front of the brows and has a lower sagittal crest. The type skull of *caucasicus*, which is indicated as a new race although the name was published years previously by Grevé, is a massive high-browed skull recalling in shape the skulls from Kamschatka described below under *beringianus* and also the Olonetz skull of *U. a. arctos*. The skull identified as *meridionalis* looks like a young-adult skull which by the development of the sagittal crest and a few more air-cells in its brow would, when mature, have closely resembled the skull of *caucasicus*. The photographs are mostly too obscure to show the degree of fusion of the cranial sutures; but in several cases, the two frontal bones are disunited, a sure sign of incompleteness of development.

Ognev [*Nature and Sport in Ukraine* (transl. of Russian title), pp. 4-5, 1924], who followed Smirnov, still further confused the question by using *dinniki* as a quadrinomial of *U. a. caucasicus* and *lasistanicus* as a quadrinomial of *U. a. meridionalis*.

Ursus arctos smirnovi, Lönnberg (*Särtryck ur Fauna och Flora Populär Tidskrift för Biologi*, pt. I, p. 28, 1925). This name was given to the bear from the northern slopes of the main chain of the Caucasus identified by Smirnov as *meridionalis* and represented by the undeveloped male skull above referred to. As stated above, I do not consider that any systematic importance should be attached to the shape of this skull.

Ursus arctos persicus, Lönnberg (*Särtryck ur Fauna och Flora Populär Tidskrift för Biologi*, pt. I, p. 28, 1925). The type and only known example of this alleged race is the skull of a cub, with a highly vaulted, convex crown, from Mazanderan, N. Persia, south of the Caspian. It was described as new on account of the large size of the teeth. The last three upper cheek-teeth ($pm^4 + m^1 + m^2$) measure $73\frac{1}{2}$ mm., the last (m^2) being 37 by $19\frac{1}{2}$ mm.; and the last four lower cheek-teeth ($pm_4 + m_1 + m_2 + m_3$) measure 82 mm. These dimensions, both in the upper and lower jaw, exceeded by 7 mm. the corresponding teeth of a skull of *syriacus*.

cited by Lönnerberg in confirmation of the novelty of *persicus*. But the value of the character is considerably lessened when the teeth of *persicus* are compared with those of the Syrian bears, first and second on my list, printed below, the difference being merely a question of $5\frac{1}{2}$ mm. in the upper jaw and 4 mm. in the lower jaw. The differences, indeed, are less than those between the second and third skulls on my list, both of which are ticketed 'Syria.' My table moreover, of the skulls of European bears shows a difference of 6 mm. in the upper and lower jaws in the two Swedish specimens, the third and fourth on the list; and the table of Kamschatkan skulls, all of about the same age with tolerably similarly worn teeth, shows a difference of 12 mm. in the upper and 11 in the lower teeth. It may also be noticed that the size of the teeth in *persicus* agrees very closely, individually and collectively, with the largest teeth of the European brown bears recorded in my table.

As above stated, the immature skull of *persicus* is highly vaulted. It slopes somewhat steeply backwards to the occiput from its highest point well in front of the parieto-frontal suture and rather abruptly and convexly over the forehead to the base of the muzzle above. In this particular it differs noticeably from the immature skull from the Trebizond district of Asia Minor recorded below. In this skull the dorsal profile has its highest point farther back, approximately coinciding with the parieto-frontal suture. From this point it slopes steeply backwards to the occiput and inclines forwards at a gently sinuous slope, almost uninterrupted in steepness, to the tip of the nasals. This skull, indeed, looks as if it would have grown into the 'low-browed' type, whereas the skull of *persicus* looks to be potentially 'high-browed', like *caucasicus* of Smirnov.

The only skin in the British Museum from S.-W. Asia, is that of a young male from Sumela, 30 miles S. of Trebizond, 1,000-1,300 ft., Oct. 10th (A. Robert, B. M., No. 6.3.6.29). The coat is tolerably thick, with moderately abundant underwool. The general colour of the body, above and below, and of head is whitish grey, but more or less mottled with darker hue when the hair is disturbed. On the shoulder-mat and for a short distance in front and behind it the tips are brownish and here the long hairs are blackish basally; but low down on the flanks the basal portion is brown. The underwool is mostly pale brown, darker along the mid-line of the back. There is no white collar. Muzzle brown, darker than head. Limbs pale brown, becoming darker towards the paws. Claws black, slender and unworn, on forepaw 1.7 in., on hind paw about $\frac{3}{4}$ in. long. Head and body, measured in the flesh, just over $3\frac{1}{2}$ ft., tail $1\frac{1}{2}$ in. Hair about 3 in. long.

In its generally whitish-grey hue this bear closely resembles Hemprich and Ehrenberg's figure of *syriacus*, but it differs from their description of that race in the dark hue of the basal portion of the hairs, the browner legs and mid-line of the back, the blackish grey claws and the black nose and edges of the lips.

From its whitish-grey colour and its locality just to the south of the eastern end of the Black Sea, I identify this bear as *U. a. meridionalis*, following Radde's application of that name to the pale bears of Transcaucasia which Satunin subsequently called *lasistanicus*; but

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the evidence that *meridionalis* is racially distinct from *syriacus* is as yet inconclusive.

The following are the principal cranial and dental measurements of the skulls from Syria, Asia Minor and the Caucasus in the British Museum :—

Locality and sex	Skull in English inches.						Upper teeth		Lower teeth	
	Total length	Cond. bas. length	Zygom. width	Mast. width	Int. orb. width	Max. width	in millim.		in millim.	
Syria ♂ immat.	13.4	12.4	7.5	6.1	2.6	3.4	68	34 × 18	78	23 × 14
" ♀ ad.	12.4	11.7	6.8	6.1	2.7	2.5	68	34 × 17	78	24 × 15
" ♀ ad.	11.4	10.4	6.2	4.9	2.3	2.5	62	30 × 15	72	22 × 14
Smyrna ♀ ad.	12.0	11.2	7.5	5.9	2.7	2.6	65	31 × 17	71	21 × 14
Trebizond ♂ cub.	8.6	8.4	4.9	3.7	2.0	2.0	68	33 × 17	74	23 × 14
Caucasus ♂ immat.	11.4	10.8	6.7	4.9	2.4	2.4	65 + (or curve)	34 × 17	73	23 × 14
Caucasus, N. Slope ♀ old.	11.6	10.8 +	6.7	5.1	2.7	2.6	64	32 × 17	72	22 × 14

No two of these skulls are alike and none resembles precisely any one of those figured by Smirnov. I can detect, moreover, no character in shape or in cranial and dental measurements distinguishing them collectively from the Swedish, Russian and Transylvanian skulls above referred to *U. arctos arctos*. Brief notes on them, therefore, will suffice. The Syrian specimens (1010 b; 1010 g, 60.4.23.4; 1010 a, 52.3.2.7) came from the Zoological Society; but there is no proof that they were menagerie-reared. The first appears to be that of a male. It is not full-sized and, allowing for the age-difference, closely resembles the Swedish male skull (Lloyd, 62.3.29.7). Like the rest of the skulls it is low-browed. The other two from Syria, both adult, I take to be females. The third has unusually small teeth, like the skull from the Engadine, but their smallness is not due to wear. The Smyrna skull (H. A. Wittall, No. 2.5.7.1) is fully adult. The fifth on the list, belonging to the skin, above assigned to *meridionalis*, from Sumela, 30 miles S. of Trebizond (No. 6.3.6.29), is quite young. The sixth, collected by St. George Little-dale and merely labelled Caucasus, I take to be the skull of a sub-adult male. It has a highly vaulted cranium very like that of the skull named *persicus* by Lönnberg and recalls skulls of similar age of the Himalayan race *isabellinus* on the one hand and some skulls of the European race on the other. The last on the list came from the

north-western slopes of the Caucasus (St. George Littledale, No. 87.12.22.1). It is an oldish female with scarce a trace even of facial

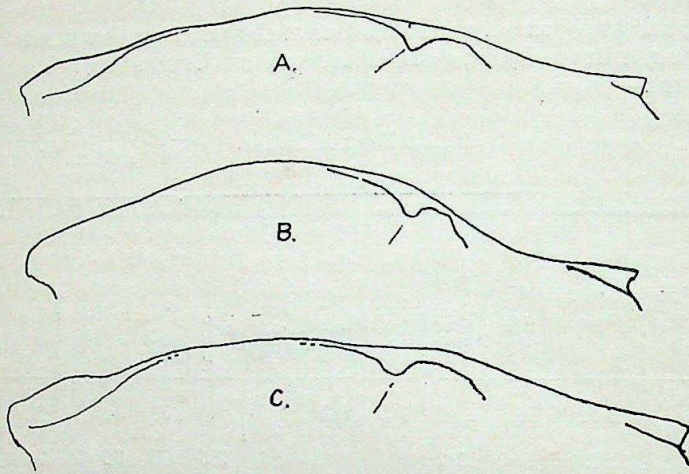


FIG. 8.

Profile variation of the upper surface of the skull of Brown Bears of Asia Minor and the Caucasus.

- A. Old female from the north-western slope of the Caucasus (Littledale).
- B. Immature, probably male, specimen from the Caucasus (Littledale).
- C. Young-adult male from Smyrna.

sutures and is indistinguishable from female skulls of *U. a. arctos* from Transylvania.

The Brown Bear of Baluchistan. (*Ursus gedrosianus*.) A bear which for geographical reasons must not be lost sight of in the present connection is *Ursus gedrosianus*, described by Blanford from an imperfect skin secured at Tump, 70 miles north of Gwadar on the Mekran coast, Baluchistan. (*Proc. As. Soc. Bengal*, 1877, p. 204, and *Journ. As. Soc. Bengal*, 46, p. 317, 1877). According to Blanford, the colour of this bear was dark rufous brown, like European examples of *Ursus arctos*, with the shoulders and outer sides of the limbs darker than the back, the muzzle whitish, the tip of the chin white and a white semicircular collar on the breast but not produced in front of the shoulder. The coat was thin, short and harsh, $1\frac{1}{2}$ ins. long on the body and $2\frac{1}{2}$ ins. on the shoulder.

The rest of the story of this bear, of the subsequently received specimens Blanford assigned to it¹, which induced him to relegate the name *gedrosianus* to the synonymy of the Himalayan Black bear (*Selenarctos thibetanus*), on the supposition that he had been deceived into describing it by the 'discoloration' of the skin of the type, will be told fully under the account of that species. It is, however, quite clear from the description of this skin that, with the possible exception of the breast-collar, the characters recorded, e.g. the colour and the presence of the long hair on the shoulder, agree much more closely

¹ Blanford's material of this bear has disappeared. I wrote to the Calcutta Museum to inquire for the skins and skulls but was told they are not there.

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with those of the Brown bear (*U. arctos*) than of the Himalayan Black bear. Finally I may add that Mr. C. E. Capito, formerly of the Anglo-Persian Oil Co., informed me that he was well acquainted with a small 'brown' bear, like the European animal, frequenting the hills of southern Persia to the north of the Gulf, a habitat very similar to 'the arid districts of the Mekran coast' whence the type of *gedrosianus* came. Blanford candidly admitted that he was quite unable to account for the occurrence of so essentially a woodland species as *thibetanus* in such an unlikely locality.

Conclusion. So far as I can judge from the material at my disposal and from the accounts published by other authors, the bears of Asia Minor and Syria merely differ from the typical Brown bear of Europe in being on the average paler in colour, intermediate specimens occurring in the Caucasus and perhaps in northern Persia.

THE SIBERIAN BROWN BEAR.

Ursus arctos collaris, Cuv. & Geoffr.

Ursus collaris, Cuvier and Geoffroy St. Hilaire, *Hist. Nat. Mamm.* pt. 42, pl., 1824; *Tabl. Gen.* p. 3, no. 212, 1842.

Ursus arctos var. *sibiricus*, Gray, *Proc. Zool. Soc.* 1864, p. 682; *id. Cat. Carn. Brit. Mus.* 1869, p. 219.

Ursus arctos jenseensis, Ognev, *Nature and Sport in Ukraine* (transl. of Russian title), p. 4, 1924.

Locality of type of *collaris*: Siberia.

" " *sibiricus* (if any): Siberia.

" " *jenseensis*: Yenissei Prov., C. Siberia.

Judging from Cuvier's illustration, the type of this bear when figured, was carrying a long and apparently tufted winter coat. The general colour of the head and body is yellowish brown, mottled with darker streaks where the deep-tinted bases of the hairs and underwool are shown. On the neck is a very broad whitish collar which not only passes over the nape in front of the shoulder-mat but apparently extends forwards to the back of the head. There is also a pale stripe on the flank behind the axilla and elbow of the fore-leg. The legs are black and sharply contrasted with the brown body.

This bear has sometimes been united with *U. arctos arctos*, sometimes with *U. a. beringianus*, sometimes regarded as a distinct variety. Provisionally, I give it racial status because it differs from all the examples of those two subspecies I have seen or read about in the great extent of the collar on the sides and nape of the neck, associated with black legs.

Its greatest interest perhaps lies in its resemblance to some examples of *pruinus*. The latter, as explained below, has black legs contrasted with the paler flanks, dark under-hair and frequently a pale area behind the axilla associated with a broad collar which may extend over the nape in front of the withers although never so wide on this area as in *collaris*.

Gray seems to have projected the name *sibiricus* into ursine literature on the strength of his knowledge that the Brown bear occurs in

Siberia. He did not apparently associate it with any definite specimen. Trouessart, wrongly so far as I can ascertain, assigned the name *sibiricus* to F. Cuvier, thinking apparently that that author had so entitled the 'ours de Sibérie', which, in reality, he named *collaris*. Gray did not assign the name to Cuvier or indicate that he himself was the first to introduce it and all that he said to give the name systematic status was that the bear is 'in all states and ages brown'.

The suggestion made from geographical considerations, that *jeni-seensis* may be a synonym of *collaris* is a mere guess on my part. The sub-species was based upon what I consider to be valueless cranial characters, and cannot be compared with *collaris*, the skull of which is unknown.

THE KAMCHATKAN BROWN BEAR.

Ursus arctos beringianus, Mid.

Ursus arctos var. Geoffroy St. Hilaire, Zool. Voy. 'Venus' Atlas, Pl. 4, 184, text, p. 121, 1855.

Ursus arctos var. *beringiana*, Middendorff, *Sibir. Reise*, II, pt. 2, p. 4, pl. 1, figs. 1-5, 1853.

Ursus piscator, Pucheran, *Rev. Mag. Zool.* 1855, p. 392.

Ursus mandchuricus, Heude, *Hist. Nat. Chin.* 4, pp. 23-24, pl. 17, figs. 1-1^e 1898.

Ursus arctos kolymensis, Ognev, *Nature and Sport in Ukraine* (transl. of Russian title), p. 6, 1924.

Locality of type of *beringianus*: Great Shantar Island, Sea of Okhotsk.

" " *piscator*: Petropaulovski, S. Kamchatka.

" " *mandchuricus*: Near Vladivostock in Manchuria.

" " *kolymensis*: Kolyma, N.-W. of Sea of Okhotsk.

Distribution: Manchuria northwards round the Sea of Okhotsk, thence southwards into the Kamchatka Peninsula.

The first recorded example of this bear was a brown cub captured at the southern extremity of Kamchatka, near Petropaulovski, and brought alive to Paris, where it was seen, when 4 years old by G. St. Hilaire and described as 'very dark brown, paler on the muzzle and throat, but deeper even black on the posterior part of the back, the flanks, croup and limbs, the claws also being black and the collar absent.'

Pucheran named this bear *Ursus piscator* without contributing anything fresh to the information regarding it or giving reasons for dissenting from Geoffroy's view that it was a mere variety of the common European Brown Bear.

Middendorff gave the name *beringiana* to two skulls, one of a very old male from Great Shantar Island, the other of an apparently adult female from the adjoining mainland of Uda Bay, on the Okhotsk Sea, in Amurland.

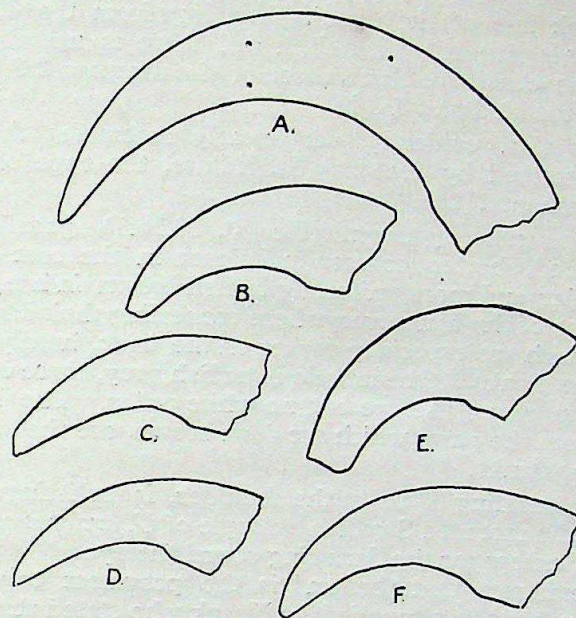


FIG. 9.

Claw of forepaw of exemplar of the Brown Bear (*Ursus arctos*), referred to in the text.

- A. Of the type of *U. a. shanorum*. Captive specimen.
- B. Of a typical Brown Bear (*U. a. arctos*) from Lake Ladoga.
- C. Of a Red Bear (*U. a. isabellinus*) from Gilgit.
- D. Of a Tibetan Blue or Snow Bear (*U. a. pruinosus*) from Kansu.
- E. Of the type of a Manchurian Black Bear (*U. a. lasiotus*) Captive specimen.
- F. Of a Kamschatkan Brown Bear (*U. a. beringianus*).

The British Museum has a couple of good skins, procured in Kamschatka by St. George Littledale, and a fine series of skulls from the same country, most of them received from the Museum in St. Petersburg. It is the evidence supplied by this material that induces me to believe the names *beringiana* and *piscator* were given to the same race of bear.

The skins show the following characters :—

1. A well-preserved dressed skin (No. 0. 10.16.2) has the coat exceedingly long, between 5 and 6 ins., with the underwool mostly moulted. The colour is very varied, mottled especially on the flanks owing to the natural disarrangement of the loose coat displaying the darker basal and lighter apical portions of the long hairs. Muzzle buff with whitish sheen; browner round the eyes. Hairs on cheeks, neck and flanks with long greyish buff tips, the bases not very dark, the general tint being greyish brown; but the dorsal area, including the 'shoulder-mat' and the fore part of the back is darkish brown, the tips of the hairs being only a shade paler than the rest, but on each side of the 'mat' the tips are nearly white, thus emphasising the

dark hue of the 'mat'. The legs from the elbows and knees are brownish black and there is no white collar. The claws are black, those of the forepaw 2·3 ins. long, of the hind paw 1·3 in.

This skin evidently very nearly resembles the example described by Geoffroy St. Hilaire, the type of *piscator*, Pucheran.

2. A mounted specimen (No. 0. 10.16.1), possibly a little faded, shorter, coarser and closer in the coat and much paler and more uniformly buffish brown in hue, the paler tips of the hairs everywhere concealing their darker bases, which are especially darker on the back, hardly darker on the flanks. The muzzle is buffish grey, there is a brown rim round the eye but no white collar. The legs, apart from the paws which are dark brown, are the same tint as the flanks.

This bear, standing 3½ ft. at the shoulder, is indistinguishable in colour from the mounted Swedish example of *U. arctos arctos* standing alongside it, except for the dark ring round the eye.

Further evidence that 'brown' is the prevalent colour of the Kamschatkan bear was supplied by Noack who stated that skins he had seen were pale coloured, like *syriacus* (*Zool. Anz.* 1903, p. 643) and by Lönnberg's description of some skins as 'brown, brownish-grey or lighter' (*Proc. Zool. Soc.*, 1923, p. 93). Sowerby's statement that a number of skins he saw from Manchuria were 'brown' induces me to add the name *mandchuricus*, given by Heude to a Manchurian specimen, to the synonymy of *beringianus* rather than to that of *lasiotus*, since all the available evidence regarding *lasiotus* points to its being black.

The dimensions of some skulls assigned to *beringianus* are as follows:—

Locality and sex	Skull in English inches.						Upper teeth in millim.		Lower teeth in millim.	
	Total length	Cond. bas. length	Zygom. width	Mastoid width	Int. Orb. width	Max. width	Last 3 teeth	Last tooth	Last 4 teeth	Penult. tooth
Shantar Isl., ad. ♂	16·8	14·7	10·8	...	4·5	3·9	75	36 × 20	...	...
Ussuri, ad. ♂	15·7	14·8	9·1+	...	3·7	3·6	...	...	...	...
Kamschatka, oldish ♂	16·6	15	9·5	...	4·1	3·6	84	39 × 21	92	26 × 17
" " ♂	15·4	14·3	9·5	7·3	3·5	3·5	76	35 × 20	86	26 × 16
" " ♂	14·4	13·8	8·8	...	3·2	3·2	72	36 × 19	81	24 × 15
" " ♂	14·7	13·8	9·3	7·4	3·7	3·5	74	35 × 19	86	26 × 15

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Locality and sex.	Skull in English inches						Upper teeth Lower teeth in millim. in millim.			
	Total length	Cond. bas. length	Zygom. width	Mastoid width	Int. Orb. width	Max. width	Last 3 teeth	Last tooth	Last 4 teeth	Penult. tooth
Kamschatka, aged ♂	15.5	14.4	9.7	...	3.6	3.6+	73	34 × 19	82	24 × 14
„ young (?) ♂	13	12.6	7.1	5.5	2.7	...	73	34 × 19	83	25 × 14
Udd River, adult ♀	...	12.4 ±	6.8	...	2.8	2.9	...	...	...	...
Kamschatka, oldish ♀	13.5	12.6	7.9	5.9	3	3.1	68	33 × 19	78	24 × 16
„ young ♀	12	11.5	6.9	5.3	2.6	...	71	35 × 17	78	23 × 14

The dimensions of the skull from Shantar Island are taken from Middendorff's figure of the type of *beringianus*. It is an old skull with the teeth a good deal worn. Similarly, the dimensions of the skull from Ussuri in Manchuria are taken from Heude's figure of the type of *mandchuricus*. In both these cases the measurements are no doubt only approximate; but in my opinion they supply no data justifying the view that these bears are distinct from each other or from the series from Kamschatka in the British Museum. The first and considerably the largest of these is actually longer in condylo-basal length than the type of *beringianus*, but the latter skull exceeds it a little in total length owing to the growth of the occipital crest with age. It is also considerably wider everywhere, especially across the zygomata. These differences are also attributable to age. The condylo-basal length of the type of *mandchuricus*, from Ussuri, compared with its total length and zygomatic width, suggests that it was not quite full-sized. Its measurements agree very closely with those of the Kamschatka skulls. The first three of these were received from the Petrograd Museum (No. 88. 2. 20. 13. 15). The fourth came from Lataste's collection (No. 19. 7. 7. 36. 10). The fifth (No. 91. 12. 8. 13) was procured by Sir G. Baden Powell on the Nalotchirk River. It is a very old skull with the teeth much worn and broken. The sixth, also belonging to the Petrograd series (No. 88. 2. 20. 17), looks like the skull of a young male.

The measurements of the skull from the Udd River are taken from Middendorff's figure of a defective skull from that locality which he assigned to *beringianus*. By analogy I have inferred the condylo-basal length to be about 12.4 ins., slightly less than that of the oldish female from Kamschatka (No. 88. 2. 20. 16), which is also wider and no doubt older. The last on the list, a young female (No. 88. 2. 20. 18), like the oldish female, belongs to the Petrograd series.

The figures of the skulls assigned, no doubt correctly in my opinion, to *beringianus* by Heude and Courtois show them to be

immature, but the molar teeth of a young specimen agree very closely in size with those of the Kamschatka skulls in my table.

As regards their shape, Middendorff's figure of the typical male skull of *beringianus* shows it to be 'high-browed'. Sowerby was apparently unacquainted with this figure, because he excluded this bear from his spurious genus *Spelæus*, a name resuscitated for the high-browed representatives of this group. He also excluded from *Spelæus* the bear represented by the skull described by Heude as *mandchuricus*. But Heude's figure shows that the brow is moderately elevated, quite as much as one would expect in a skull shown by its dimensions to be not quite full-sized, as stated above. I may add that the large size of the upper carnassial tooth, the antepenultimate of the series, upon which Heude relied as the main character for *mandchuricus*, is an individually variable feature and does not possess the systematic importance attached to it.

All the adult and old male skulls from Kamschatka in the British Museum are 'high-browed', like the male of *Ursus arctos arctos* from Olonetz in Russia, above referred to; but they vary very considerably individually in this respect, no two being alike. The adult female skull, on the contrary, is comparatively low-browed and is indistinguishable in this particular from the female skull of *beringianus* Middendorff from the Udd River.

Conclusion. I have not seen a sufficient number of skins of *beringianus* to determine whether this race differs from typical *Ursus arctos arctos* in colour; but the tables of cranial and dental measurements of the two show that *beringianus* has on the average a bigger skull and bigger teeth. Since, moreover, all the adult male skulls of *beringianus* with which I am acquainted are 'high-browed,' there is some evidence that at all events a larger percentage of the skulls of this sex exhibit that condition than is the case in the European race.

THE MANCHURIAN BLACK BEAR.

Ursus arctos lasiotus, Gray.¹

- Ursus lasiotus*, Gray, *Ann. Mag. Nat. Hist.* (3), 20, p. 301, 1867; *id. Cat. Carn. Brit. Mus.*, p. 223, 1869; Sclater, *Proc. Zool. Soc.* 1867, p. 818; Lönnberg, *Proc. Zool. Soc.*, pt. 1, p. 91, 1923.
Melanarctos cavifrons, Heude, *Hist. Nat. Chin.* V, pt. 1, p. 1, pl. 1, 1901; Courtois, *op. cit.* pl. xix.
Spelæus cavifrons and *piscator*, Sowerby, *Journ. Mamm.* I, No. 5, pp. 230 & 232, 1920.
Ursus cavifrons, Howell, *Proc. U. S. Nat. Mus.* 75, p. 21, pls. 8 and 9 (skull), 1929.

¹ I am unable to find evidence that the bears, to which the names cited in the synonymy were given, are racially distinct from each other. There are, on the contrary, many good reasons for considering them to be inseparable. But since my personal acquaintance with them is limited to a few skins and skulls, I have divided the synonymy and the account of them geographically, dealing, first, with the specimens recorded from the mainland, secondly, with those from Japan.

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(?) *Ursus arctos baikalensis*, Ognev, *Nature and Sport in Ukraine* (transl. of Russian title), p. 5, 1924.

Ursus ferox, Temminck, *Fauna Japonica*, p. 29, 1844 (not *ferox* of Shaw).

Ursus arctos yesaensis, Lydekker, *Proc. Zool. Soc.* 1897, p. 422.

Ursus yesaensis, Courtois, *Mém. Hist. Nat. Chin.* V, pp. 33-35, 1906; Sowerby, *Journ. Mamm.* I, p. 227, 1920.

Ursus melanarctos, Heude, *Mém. Hist. Nat. Chin.* IV, p. 17, pls. vii & viii, 1898.

Spelæus melanarctos, Sowerby, *Journ. Mamm.* I, p. 230, 1920.

Locality of type of lasiotus: interior of Northern China.

" " *cavifrons*: Tsi-tsi-har, N.-W. Manchuria.

" " *baikalensis*: Province of Irkutsk.

" " *ferox*, Temm: Yeso Island, Japan.

" " *yesaensis*: " " "

" " *melanarctos*: " " "

Distribution: Mongolia, Manchuria, Yeso and the Kuriles.

SPECIMENS FROM MONGOLIA AND MANCHURIA.

There appear to be only five skins of this bear from these countries preserved in Museums. Two of them are in the British Museum.

1. The skin of the type of *lasiotus*. This bear was imported as a living animal from the interior of Northern China on September 14, 1867 and presented to the Zoological Gardens where it died on June 29, 1893. In accordance with the date of death the coat is comparatively short and coarse and the underwool is in full moult, some of it still remaining attached to the bases of the longer hairs but much of it has entirely disappeared. Apart from the muzzle which is dark brown, the general colour is jet black and glossy all over, with brown reflections in certain lights and brown in patches where the hairs are disturbed, so as to display the brown underwool. There is no trace of a white collar, and the claws are black and strongly curved but much worn by the concrete flooring of the cage. The hair is about 2½ or 3 ins. long.
2. The second skin, which I assign to this race, also belonged to an adult bear which was presented to the Zoological Gardens by F. Ringer and was said to have come from the coast of Eastern Siberia. It was identified by Selater as *piscator* and died in May 1918. Sowerby who saw this specimen, when dead, said that it reminded him very much of a big black bear he shot in Kirin in N.-W. Manchuria and identified as *cavifrons*; but had softer hair. Although the animal died in May, the coat shows, perhaps unexpectedly, no sign of the moult. Possibly the moult was delayed by failing vitality due to approaching death. However that may be, the coat is long, soft and luxuriant, with abundance

of brown underwool. The muzzle is rather paler brown than in the type and there are some brown-tipped hairs on the forehead and throat. Elsewhere the general colour is mostly glossy black, but the hairs of the back are stippled with short, almost golden tips which possibly accounts for Sowerby's misleading statement that the colour was dark brown. There are no pale tips to the hairs on the rump, legs and under side. The underwool is paler than in the type and mottles the blackness with brown patches when the hair is parted. The claws are as in the type. The hair of the neck and back is between 5 and 6 ins. long, and on the flanks as much as $8\frac{1}{2}$ ins.

3. Heude's specimen of *cavilrons* from N.-W. Manchuria was also black. Hence the generic name *Melanarctos* he applied to it.
4. Sowerby's specimen, an adult male, from the I-mien-p'o district of North Kirin in Manchuria, where he shot it on October 8, is in the United States National Museum. He described its colour as generally black, merging into brown on the muzzle and head, with a band of slightly lighter colour on the shoulders, owing to the hairs being light chestnut at their bases, indicating an evanescent collar. The hair, he adds, is very coarse, with little underwool. This bear, measured in the flesh, was : head and body 6 ft. 7 ins., tail $5\frac{1}{2}$ ins.
5. Lönnberg's specimen, undated, came from Northern Mongolia. It is black with a brown muzzle and some brownish tint on the forehead and shows on the sides of the neck a faint chestnut-reddish lustre. The underwool is well developed and dark brown and the claws are blackish horn-coloured.

There is, I think, no doubt that the skins above described represent the same race of bear, *lasiotus*, which differs from *beringianus* in being mainly black instead of brown. No doubt the two completely intergrade.

I have provisionally assigned to this race the unidentifiable bear described by Ognev as *baikalensis*. As Howell observed 'its type locality is apparently the Irkutsk part of the Sajon Mountains, south of Lake Baikal, close to the borders of Mongolia, about lat. 50° N. Howell suggested that *baikalensis* might prove to be synonymous with the species he wrongly assigned to *leuconyx* which is in reality *pruinus*. The latter, so far as I am aware, does not occur north of Kansu, south of 40° N. lat. His suggestion on this head was due in part to his erroneous belief, inspired apparently by Sowerby, that the type-locality of *leuconyx* is the Altai Range. This point is further touched upon below under the synonymies of *pruinus* and *isabellinus*.

The following are the dimensions of the skulls assigned to this race. The skull of the type has not previously been measured or described.

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Locality and sex	Skulls in English inches						Upper teeth		Lower teeth	
	Total length	Cond. bas. length	Zygom. width	Mastoid width	Int. orb. width	Max. width	in mm.		in mm.	
							Last 3 teeth	Last tooth	Last 4 teeth	Penult. tooth
N. W. Manchuria, ad. ♂	16	...	9.3	..	3.5	...	...	...	...	...
N. E. Asia Type old ♂	15.9	14.9	9.4	8.1	3.7	2.7	75	37 × 19	85	26 × 17
North Mongolia ad. ♂	15.5	...	8.7	...	3.2	3.1	75	35 × 18	84	25 × 16
N. W. Manchuria ad. ♂	14.4	13.8	7.8	...	3.6	3	68	30 × 16	71	25 × 14
" ♂	14.2	...	7.6	...	3.8	3	...	...	...	...

The first skull on this list is the one recorded by Sowerby from N. Kirin, in Manchuria.¹ Unfortunately very few particulars were supplied; but so far as they go, the measurements are in very close agreement with those of the second on the list, the skull of the menagerie-kept type of *lasiotus*. But the two skulls clearly differ in the shape of the brow. Sowerby's specimen, identified as *cavifrons* Heude, has the brow high, as in adult males of *beringianus*, with a marked concavity where the forehead passes into the muzzle. In the type of *lasiotus*, on the contrary, there is no such hollow, that area of the skull being inflated with air-cells and lightly convex between the orbits, not between the post-orbital processes behind. Hence the brow is not elevated. The third on the list is the specimen, presumably adult, recorded by Lönnberg as *lasiotus*. This also has a low brow, Lönnberg expressly saying 'Our Mongolian Bear shows a cranial outline which at the forehead is nearly straight.' But his knowledge of Swedish brown bears prevented him attaching importance to this point. The measurements of the fourth and fifth specimens from N.-W. Manchuria are taken from figures of *cavifrons* published by Heude and Courtois. The figures were probably taken from the same specimen; but the dimensions do not exactly tally. The fifth at all events is the type of *cavifrons*. Sowerby examined this skull and decided that it represented the same race of bear as the

¹ Apparently the skull, assigned to *Ursus cavifrons* and figured by Howell in 1929, is the one in question. According to the photograph of the ventral view, said to be two-fifths natural size, the condylo-basal length of this skull is 15.5 ins., which is difficult to reconcile with Sowerby's record of the total length as 16 ins.; and the length of the last 3 upper cheek-teeth is over 87 mm. Since, moreover, Howell gives the dimensions of the last upper tooth as 43 × 21½ mm., it is clear that the bear has larger teeth than any known European or Asiatic bear.

much larger skull he procured at Kirin in Manchuria. Although the differences are considerable, they are not greater than those between adult male skulls of *beringianus* from Kamschatka and I see no reason for dissenting from Sowerby's verdict.

It may be noticed that whereas all the skulls of adult males of *beringianus* are 'high-browed', two out of the four known male skulls of *lasiotus* are 'low-browed'. But the skull of the type of *lasiotus*, which, by the way, is exceptionally wide across the mastoids, may have been affected by many years in captivity, although the animal was apparently full-sized, if not absolutely mature, when received. I suspect that the skull measured by Lönnberg had not attained its final form.

Conclusion. So far as the available evidence goes, this bear is as large as *beringianus* and like it in cranial and dental characters, but differs on the average at least in the prevalent blackness of its hue. It is similarly darker than the European race and also larger.

SPECIMENS FROM YESO, JAPAN

Since Temminck's account of this Japanese bear, which he identified with one of the North American races, was ignored by the later writers, who redescribed it under the names quoted in the synonymy, it is important to reproduce his description, based upon an examination of many skins possibly attesting great variation in colour.

It inhabits the mountains of Yezo and Karafto (Saghalien) and is of enormous size, the skins measuring 7 or 8 ft. long. The general colour is dark brown, more rarely blackish (*noirâtre*), some individuals being paler on the head and forequarters and some showing a yellowish band across the shoulders, resembling the variety from Siberia known as the Collared bear (*U. arctos collaris*, Cuv.). Another variety is more tawny (*plus fauve*) and is known to the natives as the 'fiery bear' (*ours de feu*) or the red bear (*ours rouge*). Temminck, however, regarded varieties as due to differences of age and of coloration of the pelage of one and the same animal.

Temminck may have been perfectly correct in regarding these brown and black skins as belonging to the same race of bears. In that case the view that *yesoensis* is distinct from *beringianus* and *lasiotus* and that these two are distinct from one another would be difficult to maintain, as will be shown in what follows. But I suspect Temminck's information was based largely upon skins observed in the market some of which may have been imported to Japan from the mainland of Manchuria, where the bears are at all events frequently 'brown'.

The only skin I have seen is that of a young ♂ from Yezo exhibited in the Zoological Gardens from 1869 to 1871, which died in June when just beginning to moult the winter coat, the underwool being detached from the skin but still adherent to the long hairs. General colour very dark brown owing to the combination of the greyishbuff tips of the long hairs with their black basal portions. The paler wash much more in evidence on the flanks than on the

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shoulder-mat and the mid-line of the back, where the hairs are almost entirely black. The newly erupting long hairs at the base of the old ones almost entirely black. Legs jet black. No trace of collar. Head lustrous brown on forehead, noticeably brown and paler than the body; the paler tint of the cheeks extending on to the throat. A quantity of wholly tawny hair in the axilla, as in *pruinus*, and the hairs of the ventral surface apically pallid, grizzled with greyish yellow. Claws black, normal in shape and length.

The resemblance of this bear to some examples of *pruinus* in colour, especially in the contrast between the paler head and the darker body, the general blackness of the hairs on the body and legs, the pale hue of the throat, chest and axilla, is unmistakable. But there is no trace of the white collar, although judging from its small size, the animal was only about half grown.

In the absence of the collar, the blackness of the limbs and mostly black body-hair, it also recalls the Mongolian and Manchurian Black bear (*lasiotus*). But the recorded skins of the latter have the head darker, not sharply contrasted with the body and scarcely a trace of pale hair on the throat and none on the chest, axilla or belly. We know, nevertheless, from Heude's description of *melanarctos* that wholly black bears occur in Yesso; and Courtois has an interesting note on a young bear, believed to be eight months old, received alive in December from Hokkaido (Yesso), which was tawny-yellow (*fauve blond*) in tint. But by October of the following year, when it was killed, it had become noticeably darker, certain parts being black. From the evidence of this cub and the half-grown specimen in the British Museum, it seems probable that the Yesso bear is brown when young and gradually gets black with age.

Sowerby maintained that there are two 'genera' of bears of this group in the Island of Yesso, namely, *Ursus yesensis* of Lydekker and *Spelaus melanarctos* of Heude. To substantiate this opinion he wrote:— 'As Lydekker distinctly states that his *yesensis* is a brown bear, while Heude states equally emphatically that *melanarctos* is pure and deep black, it is obvious that the two forms are distinct. The skull figured by Lydekker does not agree with the characters of *melanarctos*, and is, in effect, that of a true brown bear. It has a very convex cranial outline.'

There is, however, no evidence that Lydekker saw the skin I have described above. At all events he did not refer to it; and in saying that *yesensis* is a brown bear, he merely meant that it is a member of the *arctos*-group, which is perfectly correct.

Admittedly the skin described above is not wholly black, but there is so much black about it especially on the limbs and the newly erupting coat, that I have no doubt, making allowance for individual variation, it belongs to the same race as the 'black' bear from the same island described by Heude. It seems to me to be in the highest degree improbable that there are two distinct species or even races of *Ursus* found in Yesso.

As regards the skull, the untenability of Sowerby's view that the elevation of the forehead is a generic character, has already been demonstrated. Nevertheless anyone acquainted with bears' skulls can see at a glance that the skull of the type of *yesensis* (B.M.

No. 86.11.18.2), figured by Lydekker, is that of an immature animal. Hence the convexity of the dorsal cranial outline. I am quite unable to surmise why he chose that particular skull to illustrate when there was a considerably older and larger male (B.M. No. 96.4.27.1) available. But so it was. This older skull has not the convexity of outline of Lydekker's typical example. The slope of the back of the crown is almost obliterated by the sagittal crest, the forehead is not so rounded but is markedly more abruptly depressed in front of the post-orbital processes. As the measurements show, this skull belonged to a large bear with big teeth, the only peculiarity about it being the narrowness across the zygomata. But this I attribute to its being clearly a young-adult, the teeth being quite unworn and most of its cranial sutures still unclosed. Its dimensions agree very closely with those of the Northern Mongolian skull assigned by Lönnberg to *lasiotus*, a race to which *yesensis* is clearly closely allied even if it be not identical with it.

This view is confirmed by the figures of the skulls of the Yeso bears published by Heude and Courtois. Heude, as shown in the synonymy, described this bear as *Ursus (Melanarctos) melanarctos*. The male skull has a high rounded forehead, considerably higher than in the largest specimen from Yeso in the British Museum. But it is not distinguishable by any character that I consider to be of systematic value from the skull of the male Manchurian black bear he described as *Ursus (Melanarctos) cavifrons*, which Lönnberg has shown to be in all probability *lasiotus*. Heude also figured the skull of an adult female from Yeso, showing that it differs markedly from that of the male in its low, flat brow. These two skulls, ♂ and ♀ of *Melanarctos*, according to Sowerby, represent distinct genera. Courtois published fresh figures of Heude's specimens, and perceiving the immaturity of the type skull *yesensis* described and illustrated by Lydekker, quite correctly, in my opinion, regarded *Melanarctos* as a synonym of *yesensis*. It is not easy to square the exact dimensions of the figures of the skulls and teeth of these bears published by Heude and Courtois respectively. I cannot, however, find any trustworthy evidence that the Yeso bear differs in cranial or dental characters from the Manchurian bear *lasiotus*; but my acquaintance with actual skulls of *lasiotus* being restricted to the solitary type, from a menagerie-reared animal, in the British Museum, I do not feel justified in assuming that the two are sub-specifically identical, although I strongly suspect that they are.

Provisionally, I assign to *yesensis* the skull of a bear from Jelorop Isl., Kuriles (C. Maries, 80.3.30.4) which unfortunately has no skin. It is fully adult and, I think, a female. There is nothing in its characters to forbid that identification. It is slightly larger but very much the same shape as the old female skull from Kamschatka assigned to *beringianus*. Heude, it may be added, was informed of the existence of a very large black bear in the Kurile Islands (*Mém. Hist. Nat. Chin.* V, p. 1. 1901).

The following table gives some cranial and dental measurements of the skulls of *yesensis* in the British Museum and of one figured by Courtois. Also similar measurements of the skull of the type of *shanorum*.

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Locality and sex	Skull in English inches						Upper teeth in mm.		Lower teeth in mm.	
	Total length	Cond. bas. length	Zygom. width	Mast. width	Int. orb. width	Max. width	Last 3 teeth	Last tooth	Last 4 teeth	Penult. tooth
<i>Yesænis</i>										
Yeso. subad. ♂ ...	15.5	14.1	8.5	6.7	3.3	3.1	77	37 × 21	87	27 × 17
Yeso. (Courtois) ♂ ...	...	14.1	8.2	6.8	...	3.2	80	41 × 20	87	28 × 17
Yeso. (Type) ...	14.7	13.4	7.6	6.1	3	3	74	35 × 19	82	25 × 15
Yeso. yg. (?) ♀ ...	10.7	...	...	...	2.2	2.4-	68	33 × 17	...	...
Jelorop, Kurile Islds. ad. (?) ♀ ...	13.9	13	8.3	6.7	3.1	3+	72	35 × 19	79	25 × 14
<i>Shanorum</i>										
(?) Shan States, young ♂ ...	13.1	12.3	5.4	5.6	2.3	2.9	74	36 × 18	84	25 × 15

The dimensions of Courtois's skull of *yesænis* in this table are taken from his figure of the ventral surface which shows distinct traces of the occipital suture, proving that the animal was not an 'old male', as he described it. It was younger than the first on the list, which accounts no doubt for its narrower zygomata. Neither of these skulls is so old as the male skulls of *beringianus* from Kamschatka. There is, however, close agreement in their dimensions, allowing for increase in width of the Yeso skulls, if they had been a few years older. There is also no difference in the size of the teeth.

THE SO-CALLED BURMESE BROWN BEAR.

Ursus arctos shanorum, Thomas.

Ursus arctos shanorum Thomas, *Proc. Zool. Soc. (Abstr.)* p. 17 March 20, 1906; also p. 231, fig. of skull, 1906.

Alleged locality of type and only known specimen: The Shan States, Upper Burma.

The type of this bear (B. M. No. 6. 3. 16. 1) was sent to Thomas from the Calcutta Museum by Nelson Annandale who received it from Rutledge, a live-animal dealer, in whose possession it had been for a short time. Judging from the length of its claws it had been somewhere in captivity on boards for a considerable period. Rutledge told Annandale it came from the Shan States; but no bears of the *Ursus arctos* group, so far as I am aware, have been

recorded from any locality near that part of tropical Asia ; and since dealers' localities for their live-stock are frequently untrustworthy, I find it impossible to accept the Shan States as the home of this bear without further evidence.

The specimen, however, is remarkable in many ways and I cannot affiliate it with any of the subspecies of *Ursus arctos* admitted in this paper.

It is a young male. The head and muzzle are rather pale brown, paler than the nape and ears, and on the posterior part of the nape a median broad blackish brown band sets in and runs backwards over the shoulder-mat down the middle line of the back, the hairs of this band having small, reddish brown tips. On the flanks and shoulder below the mat the tips of the hairs are grey. For this reason and on account of the bases of the hairs on these areas being rather paler brown, they are markedly lighter in tint than the dorsal area. The underwool is everywhere dirty grey, darker on the dorsal area than elsewhere.

The limbs are not darker than the body, the tips of the hairs on the fore limb showing a reddish buff sheen. The chin is reddish brown, the throat-hairs are whitish at the base with pale brown tips ; the hairs of the chest and abdomen are dusky brown with pallid tips. From the tolerable abundance of underwool and the general length and condition of the coat the animal was probably in late autumn pelage. The hairs on the shoulder mat are nearly 4 ins. long, on the sides of the neck and flanks 3 ins. or more, on the back about $2\frac{1}{2}$ ins. and on the fore leg, where they are unusually long, up to 4 ins.

The claws are black and remarkably long, those of the hind paw being about 2 ins., and those on the forepaw as much as 3.7 ins. They are much longer than the claws of any example of *U. arctos* I have seen ; but I have a strong suspicion that the abnormality is not natural and is due to a comparatively long period of captivity in cages with boarded, not concrete floors.

The skull of *shanorum* has all the sutures open and is quite young as shown by its shape depicted in the figure published by Thomas, who seems to have regarded it as approximately full-sized. It is about the same age as the skull of the type of *yesensis*, but has the teeth more worn. The teeth are nearly the same size as in the type of *yesensis* ; but the skull itself is considerably smaller, indicating a smaller race of bear. It is remarkably narrow, narrower as compared with its length than the skull of any *U. arctos* of corresponding age I have seen. The frontals are peculiarly compressed towards the summit and the inter-orbital width is markedly less than the width of the maxilla at the root of the canines, an unusual feature in an *arctos* skull of corresponding age. The sagittal crest is remarkably high posteriorly for so young a bear, noticeably higher than in the type of *yesensis*. The upper carnassial tooth is large, with a big inner lobe. The size of this tooth may vary, however, individually in bears irrespective of wear, as shown by the male and female skulls of *pruinus* from the same locality collected in W. Kansu by Fenwick Owen (cf. *infra*). The last molar of the lower jaw is unusually wide and rounded posteriorly. Unfortunately, this bear had been in captivity for an unknown period and it is impossible to say to what

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extent its cranial peculiarities may have been affected by that condition.

Thomas compared this skull particularly with that of the type of *yesensis*, thinking the likeness between them, due in reality to mutual immaturity, indicated kinship. But the skull of *shanorum* is at least as much like the skull of *isabellinus*; and *isabellinus* occurs in the Thian Shan. Possibly the locality of *shanorum* was Thian 'Shan' and not the 'Shan' States. However that may be, the bear cannot on the evidence be associated with *isabellinus* because of its differences in dental and cranial characters and black claws.

THE BLUE BEAR OF TIBET.

Ursus arctos pruinosus, Blyth.

Ursus pruinosus, Blyth, *Journ. As. Soc. Bengal*, 22, p. 589, 1853; Blanford, *Journ. As. Soc. Bengal*, 46, pt. 2, p. 318, 1877; W. L. Sclater, *Cat. Mamm. Ind. Mus.* pt. 2, p. 302, 1891; Lydekker, *Proc. Zool. Soc.*, 1897, pp. 412-415 and 814; Leche in Sven Hedin's *Central Asia*, 6, pt. 1, p. 4, 1904.

Myarctos pruinosus, Lönnberg, *Proc. Zool. Soc.* 1922, p. 85.

Ursus lagomyiarius, Severtzow, *Cat. Zool. Coll. Przewalski*, p. 9, 1887.¹

Ursus pruinosus + *U. lagomyiarius* + *U. clarki* (in part) + *Spelæus leuconyx*, Sowerby, *Journ. Mamm.* I, pp. 225-226 and 232, 1920. (Not typical *clarki*; not *leuconyx* Severtzow).

Ursus leuconyx, Howell, *Proc. U. S. Nat. Mus.*, 75, p. 22, pl. 10, (skull) 1929 (not *leuconyx* Severtzow).

Locality of type of *pruinosus*; Lhasa in Tibet.

" " " *lagomyiarius*; Kansu.

Distribution.—Western China (Kansu, Shensi) and Tibet.

The literature of this bear reveals surprising diversity of opinion on its systematic status, the extremes being the view of W. L. Sclater that it is the same race as the Red bear (*isabellinus*) and the view of Lönnberg that its characters entitle it to separation from the rest of the *Ursus arctos* group as a distinct subgenus *myarctos*. Between these two are the views of others who give it specific rank. In my opinion it is a local race of *U. arctos*. I have already given my reasons for rejecting Lönnberg's view of the subgeneric importance of the species, a view based upon the large size of the teeth and the structure of the paws, both of which characters are extremely

¹ I have failed to trace the name *lagomyiarius*, Severtzow, in the bibliography of it given by Trouessart (*Cat. Mamm.* I, p. 18). The first work, *Fauna of Turkestan*, is the translation of the Russian title of the paper in which Severtzow described *Ursus leuconyx* (= *isabellinus*), but not *lagomyiarius*. The second reference is to Przewalski's *Reise Mongol.* In Vol. II, pp. 249-250, 1876, of the English translation of this work by E. D. Morgan, Przewalski refers to the bear in Kansu, but gives it no technical name. But in Severtzow's Catalogue of Przewalski's collection in the St. Petersburg Museum, of which there is a copy in the Library of the Zoological Society, the name appears; and since it is marked 'n. sp.', it must be assumed that it was first published on that occasion in 1887. Leche quotes it as a synonym of *pruinosus* and assigns it to Severtzow, but without other reference to its source.

variable. The bear is certainly racially distinguishable from *isabellinus* and from the races of *U. arctos* inhabiting more northern parts of Asia; but it shows so many cross resemblances to some of them that I find it impossible to mention a single distinctive character by which it can be defined as a species.

I follow Leche in citing *lagomyiarius* Severtzow as a synonym of *pruinus*. If Leche's statements regarding the variations in colour and other characters of this bear had been known to Sowerby he would possibly have held different views regarding it from those expressed in his paper. His opinion of *pruinus* was taken from Lydekker's account of the young and unusually grey specimen he described and figured. Its immaturity accounts for its small size, which Sowerby quoted as a specific character, and its greyness is no doubt attributable to the bleaching of the tips of the hairs of its old winter coat. These were the two features mentioned by Sowerby as distinguishing *pruinus* from *lagomyiarius*. The name *clarki* was proposed by Sowerby for a bear from S.-W. Shensi which Heude described as *Selenarctos leuconyx*. According to Sowerby this bear belongs to the genus *Ursus*; and since *leuconyx* was preoccupied for another bear, so-named by Severtzow, Sowerby substituted *clarki* to designate Heude's species. But judging from Heude's figure of the skull of *Selenarctos leuconyx*, the bear belongs to that genus and not to *Ursus*.¹ Nevertheless under the heading *Ursus clarki*, known to him only from the alleged typical skull of *S. leuconyx*, Sowerby wrote: 'When I was in this locality, S.-W. Shensi, I made enquiries concerning the form of the bear inhabiting these mountains, part of the Ching Ling Range, and was told that it was whitish in colour with some black about it. . . . The species would seem to represent *U. pruinus* in this region.' This description agrees well with the example of *pruinus* from Lhasa figured by Lydekker.

With regard to *Spheaus leuconyx* Sowerby and *Ursus leuconyx* Howell, the bears from Kansu so-named were unquestionably wrongly identified, *leuconyx* of Severtzow, from Thian Shan, being the same as *isabellinus* Horsfield, as stated below.

I have seen five complete skins of this bear:

1. A skin picked up in 1928 at Lhasa, Tibet, by Sir Charles Bell who kindly lent it to me. It is undated, but since it agrees precisely, so far as can be judged, with the skin originally named by Blyth, I shall describe it first. The general colour is black just frosted with grey and very variable according to the fall of the light, the pale tips elusively disappearing at times, then leaping up with silvery sheen as they catch the light when the skin is turned; but the pale areas on the hairs are small as compared with the black. The snout buffy, the head brown with golden reflections, the pale colour from the cheeks extending on to the throat which is dirty white, there is a good deal of pale hair also in the axilla and on the chest. A snow-white collar 5½ inches wide, interrupted in front of the shoulder by an area 3½ inches wide. The rump scarcely silvered;

¹ My reasons for this belief will be given later under the genus *Selenarctos*.

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the legs and belly black. No claws on the skin. The hair on the back measures about 3 inches, on the neck about 4 inches, on the flanks $3\frac{1}{2}$ inches. There is a good deal of underwool, brownish black in hue.

There is no date for this skin; but the condition and length of the coat suggest October or November, later at all events than the skin next described.

2. A skin in summer coat, briefly described by R. Lydekker, from the foot of Namoran Duran Pass between N.-E. Tibet and Isaidam, September 22, 1896, Capt. Neill Malcolm. (B. M. No. 0.11.13.1). Coat with the same elusive silvery sheen as in the last, Sir Charles Bell's skin, confusedly clouded black and grey, with a rufous wash on the nape and back, but the whole skin much paler owing to the dominance of the grey over the black in the individual hairs of the comparatively short coat. Snout greyish buff, head golden brown, ears brown; throat, axilla and chest pale brownish grey. The rump and legs are deep blackish brown, not so black as in Sir Charles Bell's skin, but darker brown than in any example of *U. arctos isabellinus* I have seen. The white collar, similarly interrupted above, is about 4 inches wide. The underwool is practically absent, the skin being easily exposed by parting the hairs. The hairs on the back measure about $1\frac{3}{4}$ inches, on the flank $2\frac{1}{2}$ inches; the claws are pale horn-coloured, just over 2 inches on the forefoot and over 1 inch on the hind foot. The skin measures 4 ft. 8 inches, but there is no skull whereby its age can be estimated.
- 3 & 4. The skins of an oldish female and an immature male from the Minshan Mountains, W. Kansu, generously presented to the Museum by Capt. G. Fenwick Owen and mentioned by F. Wallace in *The Big Game of Central and Western China*, 1913, pp. 195-196 and 295.
- ♂ October. Face tawny brown; ears black with hair-tips reddish buff; tips of hairs on forehead, crown and nape golden red, duller on sides of head and cheeks, no black visible on these areas unless the hair is disarranged. On the shoulder-mat the tips are less bright, buffy-grey, with the pale areas much less extensive than on the nape and not concealing the black of the basal areas. Middle line of back behind the mat like the head and with similar bright sheen; but on the flanks, loins and rump the pale tips are less extensive and less bright and turn to greyish on the upper part of the thigh. Belly dark brown, passing into red on the breast. A complete collar of wholly white hair running up to the sides of the shoulder-mat and passing in front of it across the middle line, but here the hairs are tinged with red at the base. For the rest the hairs are everywhere black at the base and there is a comparatively small amount of underwool. The hairs on the neck, shoulder-mat and flanks are from 4 to 5 ins., on the back from 3 to 4 ins. The legs are black; the claws mostly pale

horn-coloured, but streaked more or less with dark grey; the fore claws are nearly $2\frac{1}{2}$ ins. long, the hind about $1\frac{1}{4}$ ins. This skin measures 5 ft. 5 ins. to the root of the tail.

♀ October. Generally similar to the last, but with the breast and mid-line of the belly quite white and with less red on the back behind the shoulder-mat, the body here blacker, especially over the loins and rump. The claws are darker coloured, intermediate in tint between pale horn and the normal wholly dark tint of typical *U. arctos*. Fore claws much shorter, worn, only about $1\frac{1}{2}$ ins long.

These two skins agree closely with the specimens from Kansu and Tibet described by Lönnberg. They have more red, especially the ♂ first described, than Capt. Neill Malcolm's skin. The female skin is interesting from having claws intermediate in tint between the typical pale horn-colour of most specimens of *pruinus* and the dark claws of European and northern Asiatic races of *U. arctos*.

Under the name *Ursus leuconyx*, Howell recorded an immature specimen of this bear from Taochow, Kansu. He detected the resemblance of this young bear to one of Fenwick Owen's specimens photographed in the volume quoted above.

5. Skin in winter coat, described and figured by Lydekker, from N.-E. of Lhasa, Tibet, presented by Capt. H. Bower (B. M. No. 92.10.9.1). Coat very long, thick and tufted, general colour mottled grey and black owing to the tufting and disarrangement of the pallid outer part of the hair showing the dark basal part. Outer part of all the hairs of the back and flanks grey but with hardly a trace of the silvery sheen seen in the summer coat; the inner part black; but the copious underwool is brown, not black, quite grey brown on the flanks. The shoulder-mat is large and almost wholly black, flanked by white tipped hairs and preceded by a wide collar which is complete dorsally. Snout whitish, top of head and ears the same colour, grey, the ears not white and contrasted as shown in Lydekker's figure. Throat, axilla and breast white. Rump not so speckled as flanks, darker; paws and lower legs deep brownish-black. Hairs on shoulder-mat and sides of neck 7 ins., on back 5 to 6 ins.

From the length, thickness and general condition of the coat, I have no doubt this bear was killed shortly after emerging from winter quarters. The contrast between it and Sir C. Bell's specimen in colour and texture of coat is very striking but both came from Lhasa. The skin described by Blanford also came from Lhasa and there is no doubt that his original identification of it as *pruinus* was correct, although, in consultation with Lydekker, he later changed his mind on the point. This skin, like the type described by Blyth, was brought from Lhasa to Darjeeling, and had the hair felted and matted suggesting that it was nearing the moult. It exhibited a hoary appearance owing to the fulvous tips to the hairs. The hair on the back was 3 ins. long, on the shoulder from $3\frac{1}{2}$ to 4 ins. From Blanford's

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description I am inclined to think the moult was well advanced. This would account for the hair being considerably shorter than in Capt. Bower's specimen and also felted and matted. It is evident too that Blanford's specimen was not nearly so greyish-white as the other, which shows no 'fulvous' tinge in the pelage.

The head-skin of a specimen from Central Tibet, probably North of Lhasa, brought in by native collectors 'from far beyond any of the regions accessible to Europeans' (H. J. Elwes, B.M. No. 84. 3.5.1), is pale brown with a dark ring round the eyes. On the forehead the short hairs are deep brown at the base, pale at the tips; on the crown where the hair is long the colour is deeper and the pale tips little in evidence; the ears are clothed with black hairs, without pale tips.

There are three good skulls of this race in the British Museum.

The two from Kansu presented by Fenwick Owen differ considerably in shape and in a variety of other particulars, due mostly no doubt to age. The female skull is that of an oldish animal, all the cranial sutures being obliterated. Nevertheless the sagittal crest is low and short, the forehead, although broad, is not inflated or mesially depressed; the profile of the nasals is slightly undulating, with a shallow concavity in their posterior half, and the muzzle is higher and shorter than in the male. The cusps of the teeth are a good deal worn, but neither the width nor the length of the teeth appears to have been affected. The teeth are all smaller than in the male skull, the most noticeable difference being in the upper carnassial, the ante-penultimate tooth. In the female this tooth measures 16 by 13 mm. In the male it is not only longer but much wider, measuring 18 by 16.5 mm., a very remarkable and instructive instance of individual variation in the size of the teeth in bears of the same race.

The male skull has a smooth, rounded, slightly inflated forehead with small post-orbital processes, but no frontal concavity; the nasals are evenly sloped, the muzzle is long and low and the sagittal crest is scarcely developed. It may also be especially noted that the anterior border of the ascending process of the mandible does not conceal the posterior end of the last lower molar in profile view.

The skull of the specimen described by Lydekker from N.-E. of Lhasa (Capt. H. Bower, B. M. No. 92.10.9.1) is a little younger and considerably smaller than the last, but is similar in shape, allowing for the difference in age, the muzzle being even more depressed. The teeth are much smaller, although equally unworn. A marked difference lies in the mesopterygoid region. In the small Lhasa skull the post-dental extension of the palate is very short, its median length being about $\frac{1}{4}$ its anterior width. In the larger Kansu skull the median length is about $\frac{1}{2}$ the anterior width. In the Lhasa skull also the mesopterygoid fossa is markedly wider and rounded in front. It is quite clear from Lönnberg's figure of his skull from S.-W. Kansu that the post-dental palatine extension is short as in the example from Lhasa, and not long as in Capt. Fenwick Owen's specimen from Kansu; but its mesopterygoid fossa is more like that of the latter.

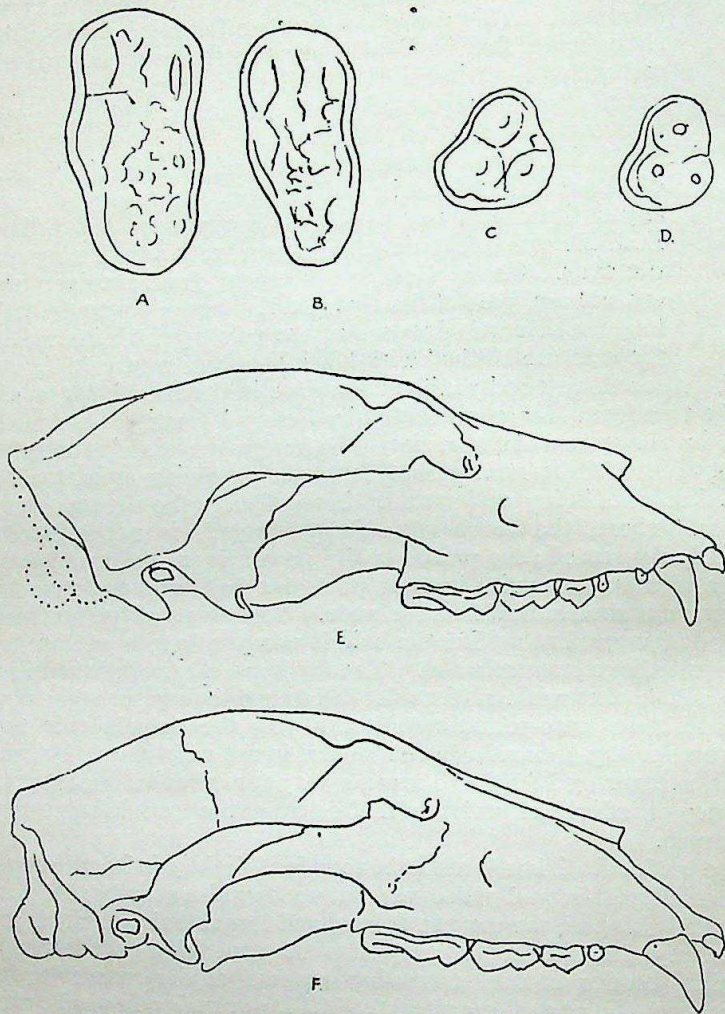


FIG. 10.

Teeth (nat. size) and skulls of Blue or Snow Bears (*U. a. pruinosus*.)

- A. Last upper molar of right side of adult female from Kansu.
- B. The same of the young female from Lhasa.
- C. Right upper carnassial (pm⁴) of young male from Kansu.
- D. The same of the old female from Kansu.
- E. Side view of skull of the same.
- F. The same of young male from Kansu.

The skull of the very old male figured by Leche differs from the oldish female skull procured by Capt. Fenwick Owen in being flatter along the crown owing mainly to the greater height of the sagittal crest at its posterior end. The line of the nasals too is straighter, without any uptilt anteriorly. Also the upper edge of the squamosal

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portion of the zygomatic arch, although more elevated and convex than is usual in *U. arctos*, is more rounded and less angled than in the female skull in which the exceptional height of the arch at this point seems due to a special ossification attested by the suture line.

The more important cranial and dental dimensions of this race, so far as they are available, are recorded in the following table.

Locality or author and sex	Skull in English inches.						Upper teeth in mm.		Lower teeth in mm.	
	Total length	Cond. bas. length	Zygom. width	Mastoid width	Int. orb. width	Max. width	Last 3 cheek teeth	Last cheek tooth	Last 4 teeth	Penult. tooth
(Leche) ♂	14.8	...	8.8	...	...	...	...	...	88	...
" ♂	14.2	...	8.8	...	...	...	...	...	93	...
" ♀	12.5	...	7.4	...	...	...	...	...	87	...
Tibet (Lönnberg) ♂	14	13.2	8.7	6.3	2.8	...	79	39 × 21	88	...
Kansu (")	11.6	11.4	6.1	...	2.5	...	84	41 × 22	95	29 × 18
" (Fenwick Owen) ♂	13.6	13	7.3	6+	2.6	2.8	83	41 × 22	92	29 × 17
" (Fenwick Owen) ♀	13.3	...	8.1	5.9	3.1	2.9	77	39 × 20	86	27 × 17
N. E. of Lhasa (?) (Bower) ♀	11.2	10.7	5.9	4.6	2.5	2.4	71	35 × 17	80	24 × 14
N. of Lhasa (Elyes)	...	...	...	...	...	2.6	...	...	...	27 × 15
Lhasa (Blanford)	...	...	...	...	...	...	...	× 22	...	26 × 16

Conclusion. The general colour of this bear may be described as blackish or black with the head and muzzle palish brown, a white collar and the tips of more or fewer of the body-hairs varying, probably seasonally, from reddish buff to greyish white, the last-mentioned phrase having inspired the name 'blue bear of Tibet'! The race seems nearly allied to the so-called 'black-bears' (*lasiotus* + *yesoensis*) of Manchuria and Japan, the resemblance, apart from the white collar, between Sir C. Bell's Lhasa skin and the second of the two skins of *lasiotus* from the Zoological Society, recorded above, being unmistakable. The claws of *pruinus* are, however, typically pale horn-coloured instead of black. The table of cranial measurements shows, moreover, that the skull of *pruinus* is a little smaller and has relatively, generally actually, larger teeth, although, their individual variation in size is considerable, as may be seen by comparing the

large upper and lower molars of Bower's skull from N.-E. of Lhasa with Fenwick Owen's male skull from Kansu. Certain resemblances in colour and in the development of the collar between *pruinus* and the little-known *collaris* were referred to above under the latter race.

THE KASHMIR BROWN BEAR.

Ursus arctos isabellinus, Horsf.

Ursus isabellinus, Horsfield, *Tr. Linn. Soc. Zool.* 15, p. 322, 1826; Adams, *Proc. Zool. Soc.* 1858, p. 517; Gray, *Proc. Zool. Soc.*, 1864, p. 686; *id. Cat. Carn. Brit. Mus.*, p. 223, 1869; and of most Indian sportsmen and naturalists.

Ursus arctus, Blanford, *Mamm. Brit. India*, p. 194, 1888.

Ursus arctos isabellinus, Lydekker, *Proc. Zool. Soc.*, 1897, p. 420.

Ursus leuconyx, Severtzow, *Nachr. Ges. Moscou*, 8, p. 79, 1873; trans. in *Ann. Mag. Nat. Hist.* (4), 18, p. 43, 1876; Noack, *Zool. Any.*, 1903, p. 642 (not *leuconyx*, Sowerby, 1920, and Howell, 1929, for which see under *pruinus*).

Ursus pamirensis, Ognev, *Nature and Sport in Ukraine* (transl. of Russian title), p. 5, 1924.

Type locality of *isabellinus*: Mountains of Nepal.

„ *leuconyx*: Thian Shan.

„ *pamirensis*: The Pamirs.

Distribution: From Thian Shan to the Western Himalayas and probably the Hindu Kush if the reddish brown bear recorded from Afghanistan by Burnes (*Cabool*, p. 163) belongs here.

Since few systematists have had skulls and skins of this bear wherewith to busy themselves creating out of it species or subspecies on cranial and dental differences due to age, sex or individual variation or on seasonal differences in coloration, its synonymy is simple. Diverse opinions have been held as to its status, many authors considering it probably identical with *syriacus*.¹ It is in my opinion a definable and tolerably well-marked race of *Ursus arctos*, as Lydekker maintained. It has not, however, been previously detected that *leuconyx* of Severtzow is a synonym of *isabellinus*. Severtzow clearly suspected that it might be; but not knowing the colour of the claws of *isabellinus* from Horsfield's description, he separated his specimens as *leuconyx* on account of the pallid hue of their claws. These specimens came from the Thian Shan range, not from the Altai as stated by Sowerby and, following him, by Howell. This mistake by Sowerby, coupled with his unacquaintance with Severtzow's description, led him to affiliate *leuconyx* with *pruinus* and wrongly to identify as *leuconyx* Capt. Fenwick Owen's Kansu bears, described above.

The description of *pamirensis* has little value; but since the Pamirs lie geographically between the Thian Shan and the Himalayan Ranges, there is no reason to doubt that the bears of the Pamirs are identical with those to the north and south.

¹ In *Sport in Many Lands*, p. 342, the 'Old Shekarry' described a bear he shot in the Caucasus as belonging apparently to the same species as the hill bear of Kashmir.

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The chief characteristics of the skins I have seen of this bear are as follows¹:—

A. Specimen from Thian Shan (St. George Littledale, B.M. No 2.3.9.2).

1. An adult undated skin, no doubt in new summer coat, the hair generally being shortish and the underwool scanty. Colour tolerably uniformly brown, the hairs of the head and body dark brown basally, darker on the back than on the flanks, the tips of the hairs being paler, buffy brown with distinct sheen. Throat, breast and legs dark brown, the hairs without pale tips. Collar represented by a dirty white patch on each side of the neck. Claws pale horn-colour; on forepaw 2 ins., hind paw 1 in. long, with worn tips. Hairs mostly about $2\frac{1}{2}$ ins. long, $3\frac{1}{4}$ ins. on the shoulder-mat. Length of skin 5 ft. 5 ins.

This is the first record of the occurrence of *isabellinus* in Thian Shan. How much farther north in Central Asia the race extends, is unknown; but neither the skin above described nor the skulls measured in the table below, supply any character by which they can be distinguished from Himalayan specimens.

Severtzow's description of this bear in the Thian Shan, where it occurs up to 10,000 ft., is good and interesting. The general colour, he said, is reddish-brown with yellow-tipped hairs and reddish-brown legs. But it varies locally. In the high plains of Upper Narin the hair is tolerably light basally, whitish terminally, the general tint being dirty white, with light brown legs. In the forests above Vernoe, from 3,000 to 6,000 ft., the general colour is reddish-brown, with yellow-tipped hairs. At Karatau, from 2,000 to 3,000 ft., the tint is very pale yellowish, the ends of the hairs being hardly lighter than the roots. But unless all the skins he saw were the same date—and there is no information on that point—some of the differences in colour he pointed out may have been seasonal. None of his specimens was apparently quite so dark as St. George Littledale's; and the variations in colour he described are not nearly so marked as in the examples recorded below from Gilgit, Kashmir, Kulu and Tehri Garwhal. Noack, moreover, records that a specimen imported to Germany by Hagenbeck was in April of one year, pale yellowish brown, with a broad brown band on the neck and shoulders, but when he saw it in the following year the hairs were tipped with white.

¹ I gladly avail myself of this opportunity to express my indebtedness to Col. C. S. Bower and to Lady Lowndes for the kind loan of the two skins from Gilgit; and more particularly to Major G. Burrard, Col. C. H. Stockley and Mr. H. Whistler for generously presenting to the British Museum the skins and skulls of their specimens, upon learning from me how badly the national collection was in need of accurately localised and dated skins of this bear, the only representative of the 'brown' bear that occurs in territory under British jurisdiction.

B. Specimens from Gilgit.

2. Adult female shot in the Tilail Valley off the Gilgit road, April 15, 1905, by Col. C. E. S. Bower, D.S.O., who kindly lent it to me for description.

The coat is long, rough and tufted, the hairs uniting in separate bundles, the dark under-hair displayed between them so as to give a mottled aspect to the pelage. General colour pale greyish brown, almost dirty white under reflected light, about 1 in. of the ends of the hairs on the back and flanks greyish buff, browner on the shoulder-mat; basal portion of all the hairs and the underwool brown, deep on the back, paler on the flanks and rump. Some white hairs on the ears and a large patch of wholly white hairs on the sides of the neck, three inches apart on the nape, forming a partial collar. On the cheeks and throat, low down on the flanks and limbs the hairs are brown, the coarse hairs on the paws having a golden sheen. The hairs on the shoulder-mat are from 5 to 6 ins. long, elsewhere on the body about 4 or 4½ inches. The claws are horn-coloured throughout, 2 ins. long on the forepaw, 1.1 inch on the hind. The dressed skin measures 4 ft. 11 ins.

3. A cub, half-grown, shot at the same time and place, and kindly lent to me by Lady Lowndes. This skin is much shabbier than the last, the coat being more tufted and curly and altogether redder, browner and less grey, the pallid tips to the hairs being worn off all down the back displaying the darker basal portion of the hair and the underwool which are much paler and redder brown than in the adult. The skin measures 3 ft. 11 ins. Whether the faded and shabby look of this skin is natural or due to exposure to light and the tread of feet, it is impossible to decide.

4. Bassin, Gilgit, May 28, 1879. (Dr. J. Scully, B.M. No. 81.3.1.3.) A young skin, 4 ft. 9 ins. long, in full moult and very shaggy. The general colour much darker brown, both on the limbs and elsewhere, than in the specimens shot on April 15 in the Tilail Valley by Col. Bower, the shoulder-mat being entirely dark brown as if composed of new hair with the tips unfaded. The body for the most part patched with buffish grey showing an almost silvery sheen in certain lights; but here and there the body hairs are all brown, suggesting the breaking off and shedding of their greyish tips. A white collar on the sides of the neck, its upper ends separated by about 4 ins. on the nape. Belly, lower part of legs and paws entirely brown. Claws pallid horn colour.

C. Specimens from Kashmir.

5. An old female from Matyol village on the Shingo Shigar River, 13,500 ft., S. of the Deosai Plateau. September 1, 1930. (Col. C. H. Stockley, B.M. No. 31.2.2.1).

A long-coated, shaggy skin with a good deal of underwool, general colour rusty brown mottled with dusky greyish black owing to the exposure of the dark tinted under-hair.

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Muzzle and head pale buffy brown, the concealed basal portion of the hairs of the head greyish black; ears covered with long hairs conspicuously white basally on the margin. The long hairs at least of the neck, shoulders and back with long reddish brown ends, blacker below, the extreme tips in many places quite grey and showing up with almost silvery sheen in certain lights. Rump and limbs darker brown, the hairs more uniformly tinted, those of the paws at least without pale tips. A conspicuous white collar on the sides of the neck, its upper ends separated by an area of about 8 ins. on the nape. The long hairs varying a good deal in length even on the same area, generally speaking about 4 or 5 ins. long. The underwool dark brownish on the back, fading to grey on the flanks.

6. Skin of a specimen from the Donahung nullah, Kistwar, Kashmir, presented by Major Whatman to the Zoological Gardens where it died in May 1918. (B.M. No. 19.2.14.1). The coat is nowhere matted or tufted, but has thick underwool. The long hairs everywhere brown basally with paler tips. On the shoulder-mat and forepart of the back the bases are very deep brown, the extreme tips reddish buff; elsewhere the bases not so dark and the tips are greyish buff with a silver sheen, giving a generally grey aspect to the skin. The underwool is dark brown on the shoulder-mat, paler on the rest of the back and becoming a pale grey on the flanks. Head and muzzle with greyish sheen. Paws brown with golden-brown sheen. A very conspicuous collar of wholly white hairs, its upper ends separated by about 9 inches on the nape in front of the shoulder. The hair on the neck is up to 4 inches long, on the shoulder-mat up to 5 inches, on the back $3\frac{1}{2}$ inches, on the flank 5 inches.
7. Kashmir, without precise locality. Mounted skin of a young specimen received from the Zoological Society (B.M. No. 52.3.2.1). Coat long and thick. The hair all over is deep brown at the base, with buffy grey tips, darker and not so grey on the shoulder-mat and on the mid-line of the back as on the flanks.

D. Specimens from Kulu.

8. Skin of young male from the Solang nullah, 7,000 to 8,000 ft. June 23rd, 1910, presented by Mr. H. Whistler (B.M. No. 29.12.24.1). Coat exceedingly tufted and curly; general colour golden brown, mottled with dark patches where the dark brown bases of the hairs, which are sharply contrasted with the paler buffy tips, are exposed by the shagginess of coat, the contrast being specially noticeable on the forepart of the back and as marked as in the Gilgit skin (No. 2), but the tips of the hairs are not so grey. Tips of hairs on muzzle and forehead nearly grey. Paws dark brown, with grey sheen. Underwool abundant, paler brown than the bases of the overlying hairs. No white collar. The hair

on the nape is $4\frac{1}{2}$ ins. long, on the shoulder-mat $4\frac{3}{4}$ ins., on the back $4\frac{1}{2}$ ins., on the flank $5\frac{1}{2}$ ins.

On the label attached to this specimen is a note by Mr. Whistler stating that, when shot, the bear was light golden yellow along the back, browner underneath. A Black bear was seen at the same time in the same nullah. The shooting of this Red bear is described in Mr. Whistler's book *In the High Himalayas*, pp.185-192.

9. Skin of an old male from the Manali nullah, in Kulu, 10,500 feet, shot in May 1931 by Capt. D. G. Lowndes who kindly presented it to the British Museum. The coat is long, thick and tufted, with abundant underwool, its shagginess giving a mottled aspect to the general coloration. Hair on the neck, shoulder and back about $3\frac{1}{2}$ inches long, on the flanks up to 5 inches. General colour decidedly sepia, not reddish brown, the tips of the hairs of the back brownish buff, of the flanks, rump and thighs buffish grey, belly, fore leg and lower half of hind leg uniformly dark brown. Underwool grey, darker on the back than on the flanks, collar represented by a tolerably large area of wholly white hairs on the sides of the neck. A quantity of whitish hair on the ears; muzzle fawn brown. Claws pale horn, almost ivory-like in hue, on the forepaw up to $2\frac{1}{2}$ inches long, on the hind about $1\frac{1}{2}$ inches. Length of skin stripped but untanned and apparently unstretched, 5 feet 5 inches.

This skin, although obtained at approximately the same time of the year and in the same district as Mr. Whistler's specimen, is very much darker and browner in hue, lacking almost entirely the reddish tinge so conspicuous in that and some other skins. It also differs in the presence of the white collar. In general appearance it comes nearest to the skin from Bassin, Gilgit, but is darker.

E. Specimen from Tehri Garwhal.

10. Skin of adult, but not quite full-sized male from the Dumdar Valley, 10,700 feet, shot on May 31, 1910, by Major G. Burrard (B.M. No. 31.1.6.3). Coat in much the same condition as in the Kulu specimen, long, thick, forming long matted tufts and with abundant underwool. General colour golden brown and mottled, but the tips of the hairs rather richer coloured than in Whistler's skin, apparently less faded, and the basal parts much paler brown so that the contrast in tint between the tips and the basal parts is not nearly so sharp even on the shoulders and forequarters, although it is noticeable there, whereas on the hind quarters, the hairs are tolerably uniformly pale throughout. Head and muzzle more golden buff, less grey than in skin No. 8. Paws not so deep brown and with a golden sheen. No white collar. Claws as in the Kulu bear pale horn colour, banded with dark grey. The hair is a little shorter than in the Kulu specimen, measuring about $3\frac{1}{2}$ inches on the neck and shoulder-mat, 3 inches on the

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back and $4\frac{1}{2}$ inches on the flank. Measured in the flesh this bear, a nearly full-sized male, was 5 feet 4 inches from the snout to the root of the tail and 2 feet 3 inches at the withers.

F. Specimen from Nepal.

11. Horsfield's typical example, said to be from the mountains of Nepal, was an undated, imperfect skin of a young specimen, measuring 3 feet 10 inches. He described it as very pale reddish brown with an obscure tint of dirty yellow or isabelline, almost uniform everywhere. The hair of the head, neck and shoulders was shaggy and curled; but on the flanks and abdomen it was short. From this description it may be inferred that the bear was killed in the spring or early summer before the moult. In colour it seems to have resembled tolerably closely Major Burrard's skin from Tehri Garwhal. So far as I am aware, this is the only record of this bear from Nepal. Probably the specimen was a traded skin from Tehri Garwhal or Kulu.

According to Adams, whose account inspired Blanford's description of this bear, the colour varies much, from dirty brownish white to dark brown, many old males being very dark brown, and is always lighter in spring than autumn. In winter and spring the coat is long, thick and shaggy; but towards autumn the underwool disappears. In the autumn the white collar is conspicuous, whereas in winter it is indistinct.

The skins above described do not altogether bear out this account, which contains no word explaining the term 'red bear' commonly applied by sportsmen to this race. Judging from the skins I have seen the term 'red' is particularly applicable to the dead and tufted winter coat, before the summer moult sets in, soon after the bear emerges from winter quarters. Major Burrard's skin from Tehri Garwhal is a good illustration. Also Col. Stockley's specimen, killed at the beginning of September, has decidedly reddish tips to the hairs on the back, shoulders and neck. Dr. Scully's specimen killed at the end of May in Gilgit is a brown bear with greyish buff tips to the hairs, but no red. Capt. Lowndes' specimen killed in May in Kulu, is also a brown bear. Sharply contrasted with these is the skin of the bear from Kistwar in Kashmir which, under reflected light, looks silvery grey; and attached to a skull from Kashmir, presented to the Museum by Lieut. Abbott, is a label describing the bear itself as 'white'. Probably it was very much the tint of the Kistwar skin. From the skins above mentioned, this bear might be truthfully described as 'grey', 'red' or 'brown'.

I cannot confirm Adams's statement regarding the collar. It is present in the Gilgit and one of the Kulu specimens in winter coat killed in April and May; traceable, but not conspicuous, in the Thian Shan specimen, evidently in new summer coat; very well marked in the Kashmir specimen shot by Col. Stockley in September, but not noticeable in Burrard's Tehri Garwhal and Whistler's Kulu specimens shot in May and June respectively. In the case of the European Brown bear the development of the collar has been

associated with age. It is said to be present at all events in many cubs, but to disappear in mature and old specimens as a rule.

The following table gives the measurements of some skulls :—

Locality and sex	Skull in English inches.						Upper teeth in millim.		Lower teeth in millim.	
	Total length	Cond. bas. length	Zygom. width	Mastoid width	Int. orb. width	Max. width	Last 3 teeth	Last tooth	Last 4 teeth	Penult. tooth
1 Thian Shan, ad. ♂	13 +	12.1	8	5.8	2.9	2.9	66	34 × 18	78	25 × 16
2 Thian Shan, yg. ♂	10.6	10.3	6.1—	4.3 +	2.3 +	2.4	68	35 × 17	76	23 × 14
3 Kashmir, ad. ♂	13.3	12.3	7.2	5.9	2.5	2.8	68	34 × 19	78	24 × 15
4 „ old ♂	13.2	11.8	7.8	6.2	2.8	2.8	71	36 × 18	77	25 × 15
5 (?) Kashmir, not ad. ♂	12.9	11.2	7.7	6.3	2.5	2.8	65	34 × 17	73	22 × 14
6 Kashmir, not ad. ♂	12.5	11.4	6.9	5.4	2.7	2.6	69	35 × 17	74	23 × 15
7 Kashmir, old ♂	12.2	11.3	7.6	5.7	2.4	2.8	64	32 × 16	70	22 × 14
8 Tehri Garwhal, ♂	13	12	7.8	6.2	2.9	2.7	69	35 × 17	77	23 × 15
9 Kulu, young ♂	11.3	10.7	6.1	4.6	2.3	2.4	70	35 × 18	77	24 × 16
10 Tehri Garwhal, old (?) ♂	11.5	10.9	7.2	5.5	2.7	2.5	...	30 × 15	68	22 × 12
11 Kashmir, ad. ♀	11.5	10.6	6.7	4.9	2.3	2.4	66	33 × 17	73	22 × 14
12 Kashmir, oldish ♀	11.1	10.5	6.7	4.8	2.6	2.4	65	34 × 16	70	22 × 15
13 Kashmir, ad. ♀	10.9	10.2	6.2	4.6	2.3	2.2	63	32 × 16	70	22 × 13
14 Kashmir, aged ♀	10.7	10	6.9	5	2.6	2.5	56	30 × 15	66	21 × 13
15 Kashmir, young ♀	10.1	9.5	5.6	4	2	2.1	65	35 × 16	70	21 × 14

Through the courtesy of Mr. R. H. Burne, F.R.S., I have also examined and measured three additional youngish skulls of *isabellinus* from Kashmir (Col. H. A. Smyth, R. A.) preserved in the Museum

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of the Royal College of Surgeons and one from Simla. Their dimensions, both cranial and dental, are in close agreement with those enumerated above.

By their cranial and dental measurements the two skulls from Thian Shan, presented by St. George Littledale, bear out the conclusion established by the skin, to which the adult skull belongs, that *isabellinus* extends as far north as that mountain range.

The ♂ skull (3) from Kashmir (Lieut. Abbott No. 56.9.22.21) is just adult; but it is interesting to note that the jaws (maxillæ) just above the canine are noticeably wider than the interorbital width. No. 4 (St. George Littledale), although old judging from its muscular development and the obliteration of its sutures, has exceptionally large upper teeth. No. 5 is unlocalised but is inferred to have come from Kashmir because it is ticketed Falconer (66.8.10.7). No. 6, a skull like the last with the cranial sutures open, was presented by Oldham (1010 f). No. 7 (St. George Littledale) is of peculiar

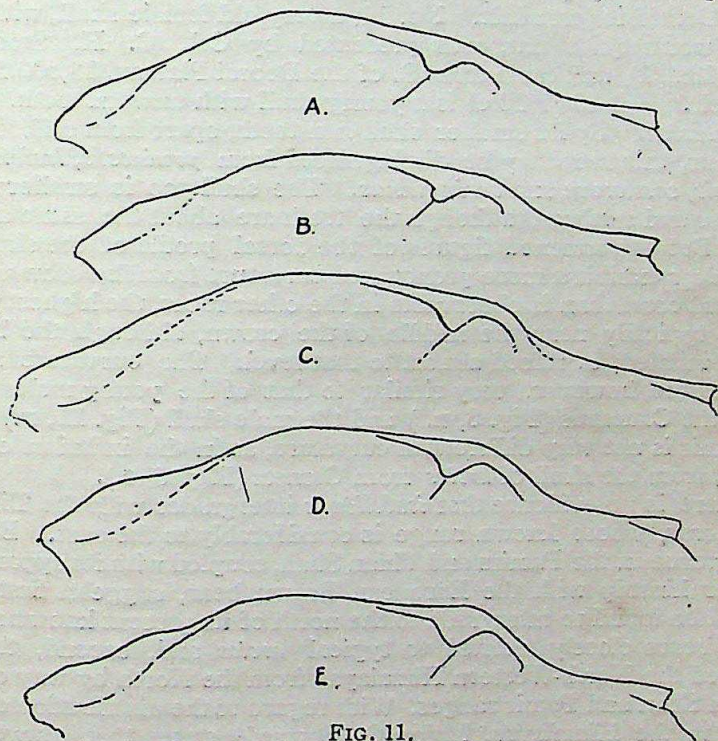


FIG. 11.

Profile variation of upper surface of skull of the Kashmir Brown Bear (*U. a. isabellinus*).

- A. Old female from Kashmir (Stockley).
- B. Young adult female from Kashmir (Abbott)
- C. Old male from Kashmir (Littledale).
- D. Old male from Kulu (Whistler).
- E. Old male from Kashmir (Littledale).

interest. - From its shape I have entered it as a ♂. It is old and about the same age as No. 4, which it closely resembles in form, but is considerably smaller and has the maxilla much wider than the interorbital width, even more so than in No. 3. The teeth too are

exceptionally small, resembling those of the females. It may be a large and unusually well-developed female skull. No. 8 is the skull of the male from the Dumdār Valley, Tehri Garwhal, belonging to the skin presented by Major G. Burrard (31.1.6.3). Its cranial sutures are not quite closed, indicating incompleteness of growth. No. 9, a young male skull from Kulu, belongs to the skin presented by Mr. Whistler (No. 29.12.24.1). No. 10 came from the Bheling Valley, Tehri Garwhal, and was presented by Capt. E. Searight (No. 30.11.1.1). It is very old with the teeth much worn. It is labelled as a male; but is small for that sex.

Of the female skulls, No. 11 was presented by St. George Little-dale (No. 87.5.5.3). No. 12 by Lieut. Abbott (No. 56.9.22.20). This is an old skull with worn teeth and is labelled 'white bear.' It is the skull figured by Lydekker, erroneously as that of a subadult animal, to illustrate the characteristic shape of the cranium in *isabellinus* (*Proc. Zool. Soc.* 1897, p. 420). No. 13, from Kashmir, presented by C. H. Donald is just adult. No. 14, a very old female skull, with the teeth worn quite flat, was presented by Col. C. H. Stockley (No. 31.2.2.1), and came from S. of the Deosai Plateau, 13,500 ft., in Kashmir. No. 15 (1010 e) is a young skull with unworn teeth.

Conclusion. By its smaller skull and teeth, apart from differences in colour, this race may be distinguished from *pruinus*, *lasiotus* + *yesoensis*, *shanorum* and *beringianus*. The skull too is smaller than in *arctos* and *syriacus*, although the teeth are about the same actual size. But the annexed figures of the dorsal profile of the skull of *isabellinus* exhibit a more pronounced curvature from the brow to the occipital crest than is observable in the other races, the highest point being typically near the middle of the crown, although the brow, when inflated, is raised almost to that level. The curvature at its greatest is, however, very similar to that of the young male skull from the Caucasus (Fig. 8, B.) and the male skull (Fig. 11, E.) from Kashmir is not very different in curvature, as in the inflation of the brow, from the skull of *arctos* from Olonetz (Fig. 6, C.).

There is no evidence that *isabellinus* intergrades with the Tibetan *pruinus*, whose known range is considerably to the east. But its occurrence in the Pamirs and Thian Shan, coupled with its apparently nearer kinship with the European Brown bear, suggests first, that it will be found to intergrade to the north of its present known range with bears closely related to typical *arctos* and, second, that it entered the North-Western Himalayas from the North by way of the Thian Shan and Pamir ranges. With regard to the distribution of this bear in the Himalayas, Major G. Burrard¹ states that its western boundary is the valley of Chitral and its eastern apparently the basin of the Bhagirathi in Tehri Garwhal. It is found on both sides of the great Himalayan Range and of its spurs, the Dhauladar and Pir Panjal Ranges, but in the latter it does not extend farther to the west than the Chenab River and in the former it does not occur immediately to the east of the Sutlej, nor between that river and the Beas river, its western limit in the Dhauladhar being Bara Bangahal, a basin at the head of the Ravi river.

¹ *Big Game Hunting in the Himalayas and Tibet*, p. 209.

A few weeks after the corrected proofs of this paper were posted to Bombay, the British Museum received an interesting example of the Kashmir Brown Bear (*Ursus arctos isabellinus*) made up as a rug and kindly presented by Sir Richard Dane, K.C.I.E. whose son shot it near the Daudwar Nullah at the top end of the Kashmir Valley, close to the foothills, but actually in the plain, at a height of not more than 6,000 ft. It was in a field of Indian corn, half surrounded by the houses of a small village, and must have come, Sir Richard thinks, either from the Pir Panjal by the Kónsa Nag Lake or from Kishtwar.

It is unlike any of the skins described above in its general cream or buffy white colour, resembling at a glance a soiled Polar Bear. No doubt the Kashmir Bear, referred to above, which was described by Lieut. Abbott as a 'white bear', was like it. But the whiteness, except on the muzzle, round the eyes, low down on the flanks, on the belly and on a large patch on each side of the neck, representing the collar, where the hairs are wholly white, is restricted to the terminal $1\frac{3}{4}$ inches or so of the hairs. Below that point they are rusty, turning browner at the base, so that when the coat is disarranged the pelage is mottled with darker patches. But the coat being comparatively short, smooth, untufted and provided with little underwool, the dark patches are not naturally displayed. The hairs on the shoulder-mat and flanks are about 4 inches, on the back about $3\frac{1}{2}$ inches long. The claws are pale horn coloured, those of the forepaw measuring just under $2\frac{1}{2}$ inches and on the hind paw $1\frac{1}{2}$ inches long.

We now have complete evidence that the 'Isabelline bear' may be white, silvery grey, red or brown, the range being from that of the Polar Bear to that of the dark brown European Bear.

The skull is that of a young adult male of the typical 'high browed' type. It is larger than any entered in the table, measuring 13.6 inches in total, and 12.6 inches in condylo-basal length, with a zygomatic width of 7.7 inches. Its length is just about equal to the largest for this race entered in Rowland Ward's Records for 1928. The teeth are average size.

(To be continued)

SOME BEAUTIFUL INDIAN TREES.

By E. BLATTER, S.J., Ph.D., F.L.S., and W. S. MILLARD, F.Z.S.

Part IX.

(With one coloured and one black and white plates and 2 diagrams.)

(Continued from page 529 of this volume.)

THE SCARLET CORDIA OR ALOE-WOOD.

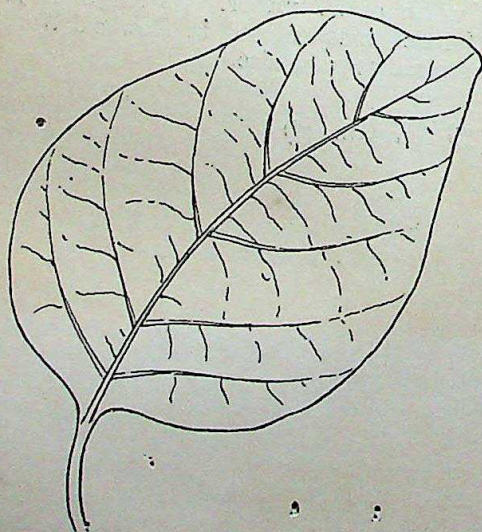
Popular Names : Sebesten Tree, Geiger Tree, Scarlet Cordia.

Cordia sebestena Linn. Sp. Pl. (1753) 190. (Boraginaceæ ; Borages).
(Named *Cordia* after Valerius Cordus, an early German botanist, born 1515; *Sebestena* means having fruits like sebestens, and sebestens is derived from the Persian Sapistan given to the fruit of an allied species, which grows in the neighbourhood of the town Sebesta.)

The genus contains about 230 tropical and sub-tropical species, mostly American; some are vines, some herbaceous, some yield drugs and others useful timbers and others again bear edible fruits. The fruit of a common Indian species, *Cordia myxa*, is used in medicine under the name of *sebesten* or *sepistan*, a term which as we have indicated above, gave the specific name to the present species.

The tree is rendered conspicuous in gardens by its bunches or clusters of beautiful orange-scarlet flowers which appear practically at all seasons of the year.

Description : A tall evergreen shrub or small tree, growing from 15-30 feet in height.



The leaves grow alternately on the branches. They are from 4-6" in length, large, oval or elliptic in shape and blunt at the apex. The leaves are rough to the touch, being much wrinkled, furrowed above and heavily ribbed below. Young plants in fresh verdent green leaf are very handsome. The showy orange-red flowers appear in large open clusters at the ends of the branches.

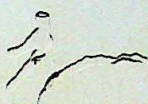
The flower is funnel-shaped, its tubular portion is enclosed for half its



THE SCARLET CORDIA OR ALOE-WOOD

Cordia sebestena, Linn.

(about $\frac{1}{2}$ nat. size)





Scarlet Cordia Tree (*C. sebestena*) in the Elphinstone Gardens, Bombay.



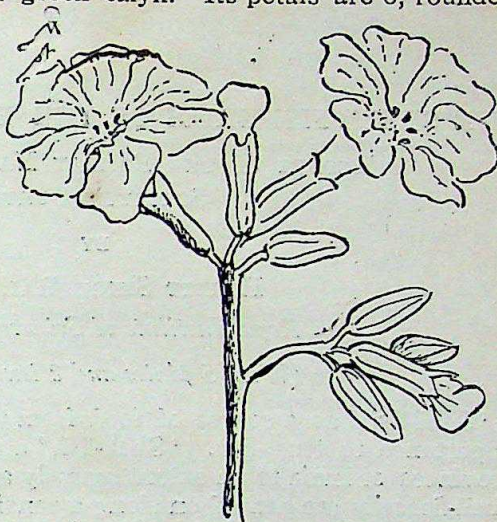
Flowers of the Scarlet Cordia (*C. sebestena*.)

length in a heavily ribbed green calyx. Its petals are 6, rounded and heavily wrinkled. There are 5-12 stamens crowned with dull yellow elongate anthers which do not protrude beyond the mouth of the corolla. The fruit is $1\frac{1}{2}$ by $\frac{3}{4}$ ". It is pure white and enclosed in a hazel-like husk formed by the persistent calyx.

Flowering Season: January-March. But the tree will be found in bloom throughout the year.

Gardening: Propagated by cuttings of firm wood and by seeds.

Native Country: Cuba.



(To be continued)

THE SHELL-FISHERIES OF THE BOMBAY PRESIDENCY.

REPORT OF THE BOMBAY NATURAL HISTORY
SOCIETY'S SURVEY.

BY

HARDIT SINGH RAI, M.Sc.,
Royal Institute of Science, Bombay.

(With 5 plates and 2 text-figures.)

'Shell-fish' as a source of food from the sea are only second in importance to true fish. 'Shell-fish' are utilised in the maritime provinces of India to an extent scarcely appreciated by most people. Shell-fisheries are carried on along a considerable portion of the Bombay coast, and in some places attain considerable proportions. In general, the chief fisheries are located in the neighbourhood of large towns and are carried on by the local fishermen for local markets.

I use the term 'Shell-fish' in the wider 'commercial' sense, and as such not only include true 'Shell-fish', (Molluscs) such as oysters, clams, cockles, sea-mussels, and cuttle-fishes, etc. but also marketable crustaceans such as prawns, crabs and lobsters.

During recent years, there has been a great advance in the development of shell-fish industries in western countries, and extensive industries have sprung up in all the maritime countries of the World, such as Japan, Great Britain, France and the United States of America.

On the Bombay coast, the industry has been completely neglected and undeveloped owing to the absence of any organised agency to look after its interests. Yet there are great possibilities for the development of Shell-fisheries in our waters.

There is an ever-increasing demand for oysters, lobsters, crabs, clams, and prawns, but the supplies unfortunately are not equal to the demand. The capital required for these fisheries is comparatively small.

Bombay, with its lengthy coast line (over 1,300 miles) and its numerous creeks and backwaters, known to produce excellent and varied forms of shell-fishes, providing an annual yield estimated at 30 lakhs, offers a very attractive field for fishery enterprise. The economic and the academic value of none of these shell-fishes has yet been realised, and nobody seems to have fully worked out the life history of any of the important shell-fishes found along the Bombay coast.

Unfortunately, the public has not yet realised the great food value of some of the shell-fishes. 'All shell-fish have the property of storing great quantities of glycogen, or animal starch, and of fat, which renders them in the highest degree nutritious, and they are, moreover, rapid growing and prolific animals—capable of extensive fishing which could be greatly increased by judicious farming'.—(C.M. Yonge, 1928.)

THE SHELL-FISHERIES OF THE BOMBAY PRESIDENCY 827

One of the factors which has prevented the greater and more general use of shell-fish as food among the higher classes is the prevailing fear of diseases, such as enteric fever, or gastric poisoning which may result from their consumption.

Greater attention should be paid to the outflow of sewage in the vicinity of shell-fish beds than has hitherto been done in India. Many shell-fish, especially oysters, clams, and mussels are liable to bacterial contamination, and, if taken from a locality heavily laden with sewage, especially when consumed raw, or lightly cooked, may cause enteric fever and other grave disorders. In the present report I have included certain measures which could be employed to obviate such contamination.

Scope of Survey.—Early in 1930 the attention of the Bombay Natural History Society was drawn by the present writer to the desirability of making a general survey of the Shell-fisheries of the Bombay Coast including Sind. In consequence of this representation, the Society deputed the author to carry out the proposed investigation and to report on the existing conditions of the Shell-fishing Industry on the Bombay Coast. The Society willingly agreed to bear the entire expenses involved in the inquiry. The Government of Bombay gave their help by granting every possible facility in the proposed investigation.

The main object of the survey was :—

(a) To discover the principal species which formed the basis of the local Shell-fisheries.

(b) To study and report upon the economic conditions under which these fisheries were being carried on and to suggest such measures as might tend to their improvement.

(c) To make collections of Molluscs and other Marine Invertebrates for purposes of study and research.

The lines on which the work was to be carried out were briefly as follows :—

1. Shell-fishes used as food, their food value and other purposes.
2. A survey of local conditions.
3. Physical conditions of the beds, habitat, etc.
4. Possible income, sale, transport, etc.
5. Fishing methods.
6. Sewage problems.
7. Possibilities of the industry.
8. Measures tending to the improvement of the industry.

It is my intention in the present report to deal mainly with the economic aspects of the problem. Such scientific results as may arise from the present investigation must be left aside until fuller opportunity is forthcoming for a detailed study of the material now made available. It is hoped, therefore, that the following reports, dealing, as they do, with the economic conditions of the Shell-fisheries of the Bombay Coast may prove of some value and I trust that such recommendations as are made may help in the economic development of the industry and tend to the betterment of the fishing population of the coast.

The most suitable time to carry out the investigation would have

been during the months of November, December, January and February, which constitute the chief fishing season along the West Coast. But my services were only available during the months of March, April and May 1930. The survey was started on March 2, 1930, and about 3 months were spent in visiting the important fishing centres to collect material and data necessary for the investigation. The time spent on tour, the localities visited, and Shell-fish collected, are given in Appendix II.

No previous investigation of this nature dealing with the area to be explored had been carried out and no information was available to provide a basis of the work. There were no records to indicate the species available at the different localities, the area of their distribution or the season of their abundance. Moreover, the work had to be carried out single-handed and the time and the funds at my disposal did not permit of anything more than a general study of existing conditions. But the material collected and the data obtained are sufficient to enable me to make some contributions to our knowledge of these fisheries and to provide information which can be made a basis for their improvement.

AREA SURVEYED.

Sind.—In the middle of March I went to Sind and visited the following localities :—

- | | | |
|--------------------|-------------------|------------------|
| 1. Karachi Harbour | 5. Piti Creek | 9. Pitiani Creek |
| 2. Manora Islands | 6. Kharanji Creek | 10. Dubba " |
| 3. Maurypur | 7. Khudi " | 11. Phity " |
| 4. Bram Haidri | 8. Khanto " | 12. Kajar " |

The Customs sailing yacht *Mary Queen* was very kindly placed at my disposal by the Customs authorities, and I was also able to benefit by the invaluable services of the Preventive officer who acted as my guide. More than a week was spent in the creeks to acquire first-hand knowledge of the physical and biological conditions prevailing in the Sind creeks. I visited all the important places where Shell-fisheries (Prawn and the Oyster fishing) are carried on along the Sind Coast.

Bombay Coast.—For convenience, the Bombay Coast (excluding Sind) may be divided into two regions (a) the Northern field, which includes districts north of Bombay (i.e. Surat, Palgarh, and Thana districts). The (b) Southern field includes Colaba, Ratnagiri and the Konkan districts.

The following localities were visited in the Northern field :—Cambay, Pardi, Arnala, Boisar, Bassein, Borivili, Varsova, Mahim, and Thana. The chief fishing centres in the North are Palgarh, Arnala, Bassein, Varsova and Mahim and the chief fisheries carried on are those of Prawn, Oyster, Crab and Lobster.

In the Southern field I visited the following localities :—

- | | | | |
|--------------|--------------|-------------|---------------|
| 1. Rewas | 5. Vi2aydrug | 9. Kodibag | 13. Sanikatta |
| 2. Alibag | 6. Malwan | 10. Ankola | 14. Gokarn |
| 3. Ratnagiri | 7. Vengurla | 11. Kumta | 15. Harwada |
| 4. Jaytapur | 8. Karwar | 12. Honavar | 16. Moorba |

THE SHELL-FISHERIES OF THE BOMBAY PRESIDENCY 829

SPECIES OF ECONOMIC IMPORTANCE.

Every creek and backwater bordering the coast of Sind has, to a greater or less extent, a shell-fish industry. A very extensive and profitable trade is carried on in Prawns, Crabs, Lobsters etc. Sind is famed for its edible oysters. In Karachi and up-country towns the demand for oysters is so great that the supply is unable to meet it. Sea mussels and cockles are also found in certain localities but they are not commercially exploited. Other shell-fish which supplement the industry are *Placuna placenta* (the Window-pane Oyster), Cuttle-fishes, and Squids.

To the South of Bombay—Alibag, Ratnagiri, Jaytapur, Malwan, Vengurla and Karwar comprise the main shell-fish-producing waters. The chief products of the Shell-fish Industry of the South are the edible oyster, clams, prawns, crabs and lobsters. Bombay possesses a fine clam (*Tapes*, *Meretrix*) industry and produces over 4 million pounds of clams each year. In addition to these, many other marine molluscs are utilized, including the following:—*Mytilus Solen*, *Venus*, *Arca*, *Umbonium*, *Purpura*, *Natica*, etc. The most important of the Cephalopods are *Loligo*, and *Sepia*, which are found all along the coast in fairly large numbers. Crustaceans (prawns, crabs and lobster) form the largest and the most valuable shell-fish along the Bombay Coast.

Shore collection was made on all occasions from the different localities visited. The collection made is large, and has been sorted out, labelled and will be placed in the Society's Museum. The most important forms collected are the following:—

Ostrea (edible oysters), *Placuna placenta* (window-pane oyster), *Tapes*, *Meretrix* (clams), *Mytilus* (sea-mussel), *Cardium* (sea-cockle), *Pecten* (comb-shell), *Arca*, *Dosina* (cockles), *Purpura*, *Umbonium* (whelks), *Cypraea* (cowries), *Cephalopoda* (squids, cuttle-fish, etc.), prawns, crabs, etc.

I propose to divide the report in two parts: The first part will deal with the molluscan shell-fish and will include the following forms, Clams, Oysters, and other minor shell-fishes (including Bivalves, Gastropods and Cephalopods). The second part will deal with the crustacean forms and will include the prawns, lobsters, and crabs.

In the following pages an attempt is made to bring to the notice of the public and the Government, the great economic value of the Bombay Shell-fisheries, and to show the present position and the future prospects of the industry. Everything possible was done to obtain reliable information and correct statistics, but for such a vast field of inquiry some allowance must be made for errors.

I desire to express my great appreciation to the Bombay Natural History Society of the honour done to me by entrusting me with this enquiry.

My greatest indebtedness is due to Mr. S. H. Prater, C.M.Z.S., M.L.C., Curator, Bombay Natural History Society, for his generous assistance and advice in all matters pertaining to this inquiry and for the great help he rendered in reading through the manuscript.

I wish to express my best thanks to Prof. P. R. Awati, I. E. S., of the Royal Institute of Science, Bombay, for his kind permission to

make a survey of the Shell-fish industry of Bombay and to work in the Institute Laboratory. Moreover, I am grateful to him for the keen interest he showed in this work.

Finally, I take this opportunity to thank the officers of the Salt Revenue Department, and of the Revenue Department for the trouble they took to assist in every possible way in the present inquiry and for the help they have given at times by placing their personal knowledge of the subject, at my disposal. I would specially thank Mr. H. T. Sorley, M.A., I.C.S., Collector of Salt Revenue, Bombay, and the Collector of Customs, Karachi, for the great assistance I received through their departmental officers in my investigation.

I

BOMBAY CLAM INDUSTRY.

The Bombay Clam Industry is of great economic importance due to the following facts : (1) Clams provide cheap and nourishing food (2) they are sufficiently abundant, and form a source of supply during the monsoon when fish is scarce and (3) clam-fishing gives employment to a very large number of people who gather them for the market.

'Clams' form a popular diet among the poor people living along Bombay coast. They are prized by the fishermen above all other food molluscs except the oysters. They are chiefly used in curries, especially during the monsoon when fish is scarce, and are much valued because they are cheap and tasty. The usual retail rate varies from 2-3 pies per pound in the Bombay markets and in the mofussil a pie's worth is sufficient to make a good curry for a whole family. Though Clams have been used as food for ages, and though commonly eaten by the poorer classes, they are not very popular with the well-to-do Indians. The fishermen use these shell-fish all the year round.

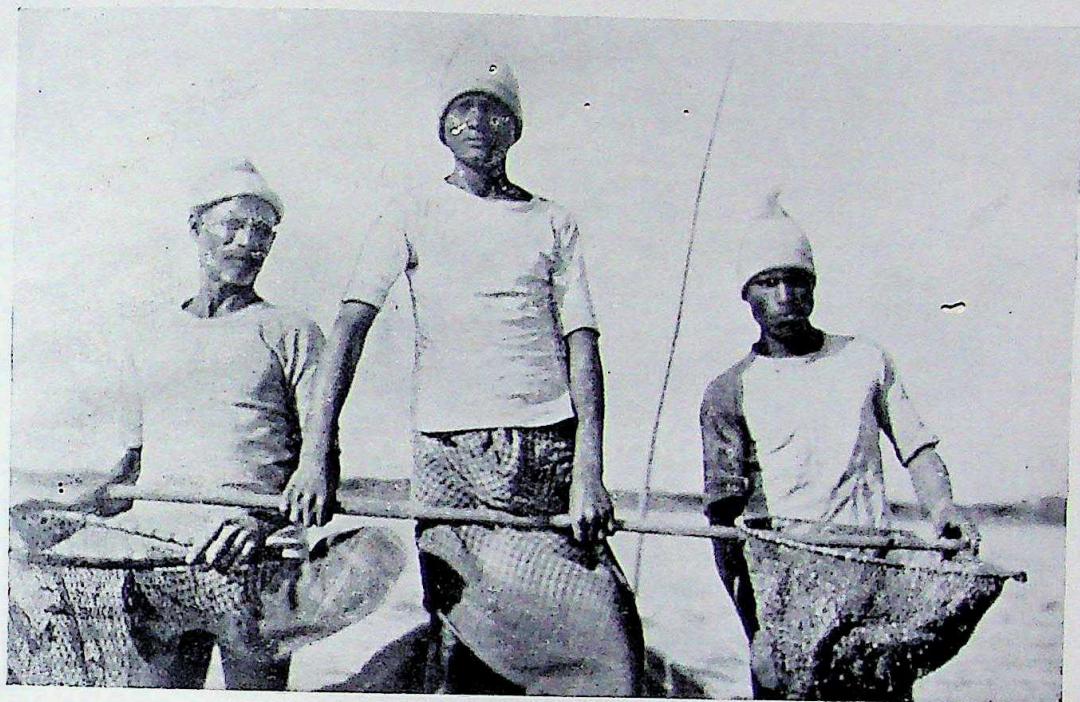
Bombay clams.—Two important clams are found along the Bombay coast.

(1) *Tapes*.

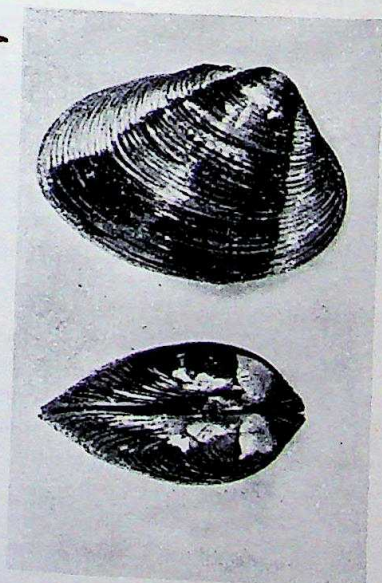
(2) *Meretrix*.

1. *Tapes*. In commercial importance, the *Tapes* stands first among the true shell-fish of the Bombay coast. It is a brackish-water mollusc and has a wide distribution from Bombay to the South all along the coast. There are very few creeks in the south where this clam is not found. This is due to the excellent nature of the creeks with their large stretches of clean sandy ground. It also lives in deeper waters (one to three fathoms) and in many localities often remains submerged under water. It is found in sand but as frequently in areas where the sand is mixed with considerable quantities of mud. The most favourable place for *Tapes* beds is a sandy bottom with a little mud—too much of fine mud destroys them. They are readily injured by high temperature. In most of the creeks where the beds are exposed under low tide for a long time during the summer months, they are killed in large numbers.

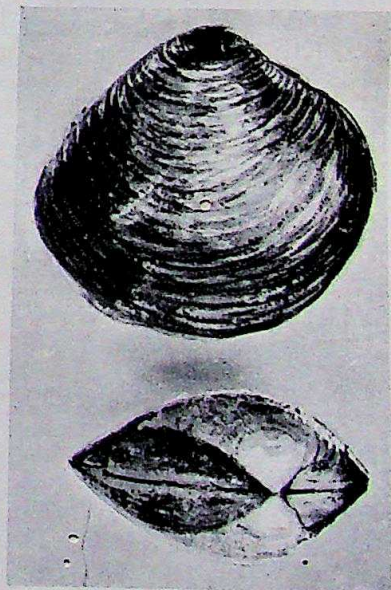
2. *Meretrix*. This clam has the same habitat as the *Tapes* and is generally found in the same beds. Its flesh has a fine flavour and is



1. Fishermen with 'Clam net' hauled out (Mahim).



2. *Tapes pinguis*.



3. *Meretrix impudica*.

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nutritious. The shell is thick and massive. The average size in the adult stage varies from 60 mm. to 70 mm. with a weight of about 4 ounces. There are many species of *Meretrix* found all along the coast, two of which are very common, *M. impudica*, and *M. meretrix*.

Life history:—The life history of the clam is very interesting. The male and the female products, when ripe, are discharged in the water where they unite. After fertilisation the larva passes through the trochopore and veliger stages. The length of the swimming period of the larva varies according to the temperature of the water. In favourable weather conditions it takes 5-8 days for the embryo to settle down. The tiny little clam attaches itself to shells, pebbles, sand grains or sea weeds by means of a secretion from the foot, which is known as the byssus. When the foot is sufficiently developed, the clam burrows into the sand and remains buried there for the rest of its life. It grows to the adult size in about 2 years. The principal breeding season lasts from March to June; but, if weather conditions are favourable and the temperature high (above 82°F.), they breed all the year round, except during the monsoon.

Distribution of the clam beds:—Clams occur in large beds in many localities along the Bombay coast. Bombay, Alibag, Ratnagiri, Jaytapur and the North Kanara District possess the most important clam fisheries. In some creeks, like Ratnagiri, Jaytapur and Kodibag (Karwar), hundreds of acres of clam beds are exposed under the low tide.

In North Kanara District, the beds are more numerous than elsewhere and they are also very extensive in area. *Tapes* and *Meretrix* occur in such abundance in North Kanara that an important industry has arisen as a result of which a considerable number of hands are always kept employed. The towns possessing important clam fisheries in Kanara district are: Karwar, Kodibag creek, Ankola, Moorba, Wadgoni creek, Mirgan, Harwada, Mudgian, and Sanikatta.

I estimate the area covered by clam beds at 350 acres in Kanara district and about 300 acres in Ratnagiri district, and other minor beds all along the coast may be put down at 250 acres. Altogether, there are not less than 900 acres of clam-bearing sands in the whole Presidency.

To the north of Bombay there is practically no clam industry because the shore is rocky and muddy and the grounds are not suitable for the growth of clams. Along the Sind coast these shell-fishes are absent so that there is no such industry along the Sind coast.

Value of yields:—The Kanara clam industry ranks first on the Bombay coast and the annual production from the different beds may be estimated above 2 million pounds. The Bombay markets are supplied from the Mahim creek and other creeks to the south of Bombay, the market depending chiefly on Alibag for its supply. Very large quantities of clams are consumed in Bombay. The annual consumption may be estimated to 190,000 pounds valued at Rs. 50,500.

These clams were, at one time, much more abundant along the Bombay coast. Thirty to fifty years ago the southern creeks were full and the beds crowded with them. With the increase in demand

from the larger towns along the coast and the mofussil and the consequent ruthless exploitation of the clam beds, and with no State control over the fisheries, the supply has steadily diminished and clams are becoming scarcer and scarcer every year.

The crop varies from year to year, there are some good years and some lean. From my inquiries among the fishermen I am led to believe that poor yields may be due to excessive rainfall. When the creeks are continuously flooded with fresh water brought by the streams in the monsoons, the clam beds are affected to a large extent since the shell-fish die on account of the greatly reduced salinity of the water present over the beds. When the rains are normal the beds produce fairly good harvest.

It is difficult to estimate the productiveness of these beds. One naturally expects the official records to say something about them, but no such information is available. On account of this, an exact estimate of clams collected along the coast, is impossible. However, at a general estimate, the total production of the Bombay coast may be placed approximately at 4 million pounds and the approximate value of the clam industry may be placed at Rs. 1,02,000.

Marketing :—The clams are generally marketed alive. They are also sold with the shell removed. The shells are broken against a stone and the meat is extracted with a push of the thumb, and dropped into an earthen pot containing a little of fresh water. Clam-meat absorbs a large amount of water so that it increases in volume by about a third of its original size. That is why the clams are generally soaked in fresh water before being marketed. After satisfying the local demands they are sent to the interior towns.

The commonest method employed for preserving clams for the market is to boil them for about 20 minutes. This causes the clams to gape. The meat is then shaken out and dried, and in this condition, forms a very delicious food, particularly during the monsoon, when fish is not readily available. The other method which is also very common, is inserting a sharp instrument, a 'Clam Knife', between the shells and pressing them aside, the soft parts are then easily scooped out. The large clams are opened by this method, while the smaller ones, which also form a part of the catch are boiled and the stew or boiled water is used in curry. The boiled meat does not smell and is eaten when dry. It is sold at the rate of 5-6 annas a pound, while the dried meat is cooked or is used in curry and is sold at annas 4-5 a pound.

By-products :—Large heaps of clam shells are met with all along the coast wherever the clams are found in abundance. The shells are sold to the lime burners, who burn them in kilns and produce a good quality of lime used extensively for whitewashing purposes.

Sewage problem :—Clams are much more liable to bacterial contamination than any other Shell-fish. The oyster beds may be established far from the shore where there is little danger from contamination from the sewage. But clams are found chiefly in backwaters and creeks, so that there is greater danger of their contamination by polluted waters. The beds which were known to produce good clams have become quite barren as a result of sewage accumulations in the neighbourhood. The fishing grounds



1. 'Clam' fishing at low tide at Jayatapur.



2. 'Tony' full of 'Clams' after fishing at Jayatapur.



3. 'Clam' fishing in deep water at Kodi-bag, Karwar.

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which have survived destruction in this way are those situated near the middle of the creeks where the water is deeper, and the currents more strong.

In Mahim Creek (Bombay) where the clams are gathered in large quantities for the Bombay markets, the sewage conditions are even worse. The sewage gutters from Bombay city open into the creek. The clam beds which once produced excellent quantities of clams are now destroyed by the soft odorous mud brought along with the sewage. The conditions are so bad that there is every danger of contamination of the beds. A large amount of clams which are gathered and collected from this foul creek are sent to the Bombay markets.

Fishing Methods:—The fishing is generally done at low tide, when a large area of the beds is exposed. The work is done to a large extent by women. Each woman on an average collects about 10-12 lbs. of shell-fish, worth about 3 annas, per day.

Two methods of digging clams are commonly employed on the Bombay coast: (1) 'Dry Digging', (2) 'Wet Digging'.

1. 'Dry Digging' is carried on only when the waters have receded and it lasts only for a few hours every day. The instrument usually employed for digging consists of an iron prong with a wooden handle attached to it. The clam-collectors however use all sorts of diggers, such as cocoanut shells and iron levers at different places along the coast.

2. 'Wet Digging' is employed when the clam beds are covered by water even at low tide. A small boat and a 'Clam rake-net' are required for the purpose. The fishermen generally take their boats into 4-5 feet deep water where they can use their 'rake-nets'. The boats are anchored when the fishing ground is reached. The men wade into the water over the clam flats and locate and dislodge the clams by groping with their feet. The rake net is worked into the sand and mud, and then drawn up with the catch. It is washed repeatedly to rid it of the sand and mud till only the clams are left in the net. These are emptied in the boat, where they are sorted at leisure.

The structure of the 'rake-net' is very simple. The rake which consists of a semi-circular wooden rim has a diameter of $1\frac{1}{2}$ feet. The net with a mesh of about $\frac{1}{2}$ inch is attached around the rim. A long bamboo fixed across the rim serves as a handle to work the net into the sand and mud. In deeper waters clams are fished by diving.

In some southern creeks (Belleykeri) a slightly different type of rake-net is used. The rake is without the bamboo handle; instead, a number of strings are attached to its rim bearing small wooden floats. This type of net is generally used in deeper water. The fishermen dive and fill up the net with clams along with the sand and, coming up the surface, haul up the net.

Clam-farming:—No clam-farming is practised along our coasts except that in certain localities 'seed' clams are collected from different beds and planted in suitable tidal flats, where conditions are very favourable for their growth. There they usually grow to marketable size within a year or so. In Bombay (Mahim creek) the clam

beds are generally stocked with seed clams from different localities (e.g. Alibag, etc.). The Mahim creek beds are very favourable to their growth so that in a year or so the seed clams are ready for market. Large quantities of clams estimated to amount to 250,000 pounds per annum valued at Rs. 1,200, are sent from Alibag for Bombay markets.

Suggestions:—The reader may judge from the foregoing description that the clam industry is very important from an economic point of view. Clams provide food for a large number of people and, as such, have a distinct value in the food market. However, for want of scientific and legislative control, the industry has been left undeveloped and allowed to deteriorate. Regulations for control would go far to place the industry on a better footing, to reduce wastage and needless destruction, and to extend the possibilities of its development.

The following measures may be adopted :—

(a) *Legislation*. Laws against indiscriminate fishing.

1. *Size limit*. A minimum size below which clams may not be fished or marketed should be legally enforced and this may apply to Bombay and all districts south of Bombay. The minimum size may be fixed at $1\frac{1}{2}$ inch in length. This would afford the clams a chance of spawning at least once before they were fished out for the market. Such protection would save the clam beds from exhaustion. Thus when the clams are under the proposed marketable size, clam fishing would stop automatically. During this time the beds will be left undisturbed and the clams will get time to grow and spawn, and the fishing will again become abundant.

2. *Close season*. The fishing should be suspended during the summer months (March to June), the main period of the spawning season.

(b) *Scientific measures*.

1. Further investigation is necessary into the life history, the breeding seasons, time of maturity, rate and conditions of growth, enemies, food, etc. to provide preliminary data essential to the institution of measures for increasing the clam supply.

2. Institution of cultural methods, and the adoption of clam planting on barren and depleted grounds.

II

OYSTER INDUSTRY.

From time immemorial oysters have been considered a delicacy ; as such they are highly prized. It has been proved by many experiments that oyster flesh has a very high food value, as it contains a very high percentage of glycogen and nitrogenous compounds. The oyster is rich in Vitamins and Iodine ; both, essential constituents of human diet. Few articles of food are more nourishing than the edible oyster, but its chief merit lies in its being easily digested. Another good point regarding it is that the oyster possesses a great stimulative property, and acts as a tonic to the consumer.

BOMBAY OYSTER INDUSTRY

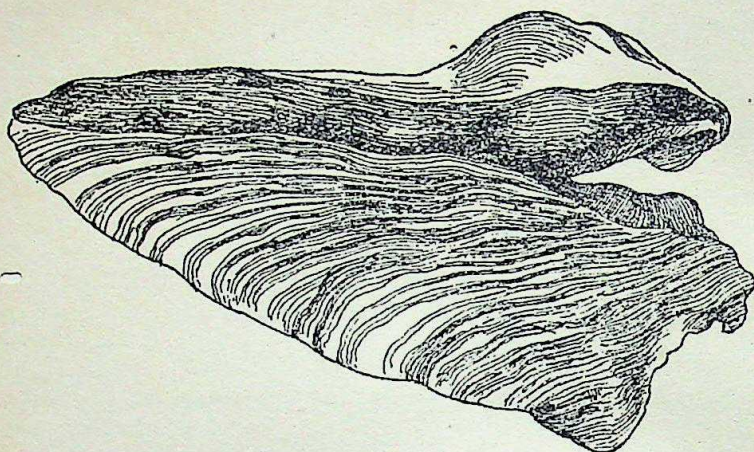
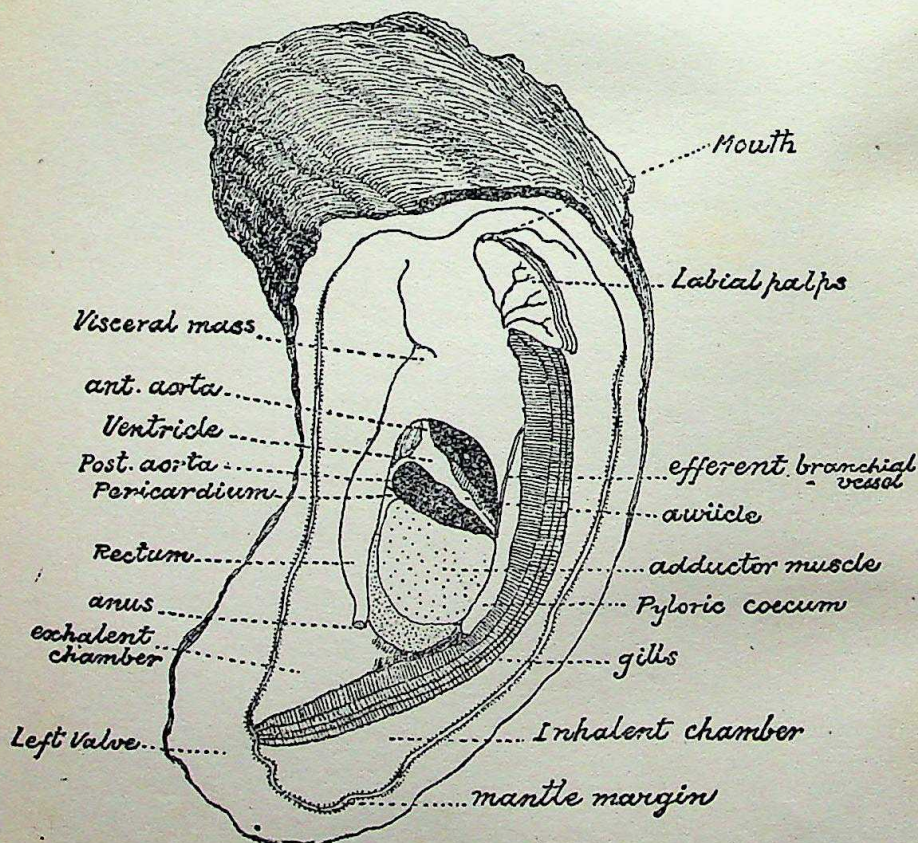


Fig. 1.—SHELL OF *Ostrea gryphoides* (SCH.) $\frac{1}{3}$ NAT. SIZE



Internal Organs (soft parts)
 $\times \frac{1}{3}$

FIG. 2.—ANATOMY OF *Ostrea gryphoides* (SCH.)

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Unfortunately the better class Indians do not make use of this excellent food found along our coast, and only the Europeans appreciate the oyster. The poor and lower class people living on the shore also make use of this most valuable article of food.

Species of Economic value :—About 7 or 8 species of edible oyster are found along the Bombay Coast : of these, the following three are important from the economic point of view :—

(1) *Ostrea gryphoides* (Sch.).—Newton and Smith. (Plate III.)

This is a large oyster growing to about 6-7 inches. The rate of growth is very rapid. The oyster attains marketable size in 3 or 4 years. It is found in the muddy creeks, where it is restricted to the low-tide area. It is sometimes found in fairly deep waters—up to three or four fathoms. This oyster is valuable because it grows to a large size (some oysters in my Sind collection are from 12 inches to 15 inches in length) and can be easily cultivated. It thrives in nearly every estuary and backwater along our coast.

Distribution :—The chief centres where this oyster is found are : Sind—Karachi harbour and Sind coast (Hub-river, Kharanji, Khudi, Khai, Pitiani and Dubba creeks).

Bombay and Suburbs.—The location of the natural oyster beds are :—Malad, Boisar, Satputi Creeks, Palghar, Sanjam Kalve, Dahisar, Navapur, and Mahim.

To the South of Bombay :—Alibag, Ratnagiri, Jaytapur, Malwan, Vengurla, Goa (Portuguese India), Karwar, Gangawali Tadri and Honavar.

Other places where these oysters are found along the West Coast are :—Cutch creeks, Okha Port, Dawaraka and Porebunder.

¹ (2) *Ostrea cucullata* (Born.).—A rock oyster, found in clusters on rocks exposed at half tides. It seldom exceeds three inches in length. This oyster seems to be a slightly brackish-water form. This species ranks next to *O. gryphoides* (Sch.) in commercial importance. It has a very delicate flavour and is therefore highly esteemed.

Distribution :—It is found along the rocky coasts in the high-tide area. It has been collected from the rocks all along the Bombay coast.

(3) *Ostrea discoidea* (Gould) or *O. rivertans*.—(Plate IV). This is a flat large oyster, almost round in shape. The external surface is laminated and the lines of growth are conspicuous. The muscle scar is oblong and has a dull white colour and stands out clearly from the nacreous interior of the valves. Its shell is generally encrusted with algæ. It is more a deep-water form and grows to 6 inches in size.

Distribution :—It is found in the littoral zone at Karachi and in the Sind Creeks, Dwarka (Kathiawar), Bombay (Mahim), Ratnagiri and Jaytapur.

Other species of oysters which are not mentioned above are rare and smaller in size. They may, however, be interesting from the

¹ Awati, P. R. and Rai, H. S. (1931).

standpoint of the study of their Bionomics, but they are useless at present for commercial purposes.

Karachi and Sind Coasts. Till the beginning of the present century, the Sind creeks produced edible oysters in great abundance and Karachi was known for the excellence of its oysters. The oyster industry before 1894 was not under official supervision and no customs dues were paid prior to this period. The trade in edible oysters began in about 1885. First, the demand was purely local and there was no difficulty in meeting it. The oysters were mostly fished from Karachi backwaters (Maripur and Nawa Nar oyster beds), where large beds existed before, and are now practically non-existent.

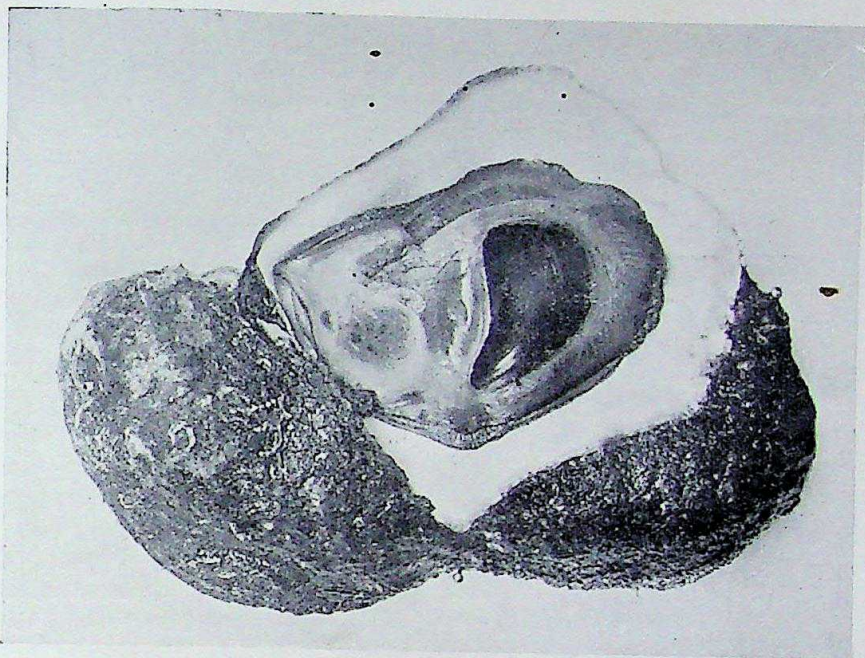
The oyster beds in the Sind creeks were so rich 'that till 1893 no difficulty was experienced in meeting the large and increasing demand'.

The customs authorities estimated the annual yield of the Sind beds during the fat years of the early nineties at 100,000 dozens.

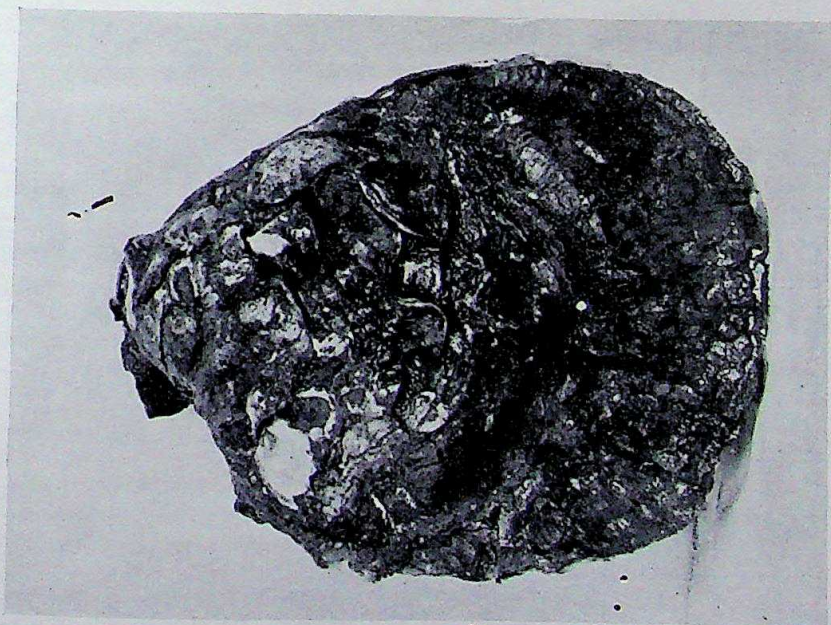
The moderate supply from the local beds was insufficient to meet the increasing demand for oysters in the Punjab, N.-W. F. P., Baluchistan, which was made possible by the opening of the N.-W. Railway which provided accelerated means of transport. The fishermen then directed their attention to beds in the Kharanji and other Sind creeks. At present the condition of these oyster beds is far from good, because they have been depleted through overfishing

Statement showing the number of oysters imported into Karachi from December 8, 1896 to June 29, 1908.

Year.	Indus Creeks. Dozens.	Karachi Nawar Nar. Dozens.	Hab-river. Dozens.	Cutch. Dozens.
1896-97	9,000	...	...	3,000
1897-98	17,150	...	...	...
1898-99	16,900	900	1,700	...
1899-1900	15,700	...	600	17,000
1900-1901	8,503	...	500	19,500
1901-1902	9,300	340	...	17,300
1902-1903	1,750	190	...	21,000
1903-1904	...	70	500	17,500
1904-1905	...	100	3,400	6,500
1905-1906	13,030	...	...	7,900
1906-1907	4,930	...	...	8,900
1907-1908	...	875	1,100	4,800



1. *Ostrea discoidea* (Gould). The right valve removed.



2. *Ostrea discoidea* (Gould).

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Statement showing the number of oysters fished in Karachi and from the Sind Creeks.

Year	Dozens	Royalty
1921-22	7,635-1	Rs. 636 A. P. 7 6
1923-24	15,288-6	1,051 13 6
1924-25	5,441-4	495 13 11
1925-26	3,519-2	502 1 8
1926-27	4,998½	860 2 0
(Closed)		
1927-28	983	172 6 0
1928-29	5,049½	1,086 8 6
1929-30	3,857	799 9 6

Oyster Season. 1929-30. Nov. 22, 1929 to February 19, 1930.

	Bram Hydri Rocks.	Dubba.	Piatiani.	Maurypur	Phity.	Kajar.	Hab River.	Kharanji.	Khudi.
Dozens ...	163	780	1,329	284½	536	334½	250	55	125

Grand Total=3,857 Dozens. Royalty recovered=Rs. 799-9-6.

It is interesting to note that 21,000 dozen oysters were imported into Karachi from Cutch creeks in the year 1902-03 but the trade diminished later because the State authorities began to charge very high taxes for the oyster exports from the Cutch State creeks to British India, i.e. Karachi. At present there is practically no trade with Cutch. During the last 30 years the oyster beds in Karachi and Sind Creeks have been practically wiped out. The demand for oysters has increased and the orders at Rs. 1-8, Rs. 2 per dozen are even refused for want of supply, but nothing has been done so far to increase the supply for the markets.

Attempts have been made by the customs authorities at Bram Hydri (Kharanji Creek) to breed oysters. But, so far, they have not been successful for the following reasons:—

1. Small extent of the natural oyster beds, to supply the Government groynes with spat.

2. Absence of any cultch in the creek.

3. Presence of soft mud which does not allow the cultch to remain clean and smothers the young spat when it settles down.

Bombay. To the south of Bombay the chief oyster-producing centres are Ratnagiri, Jaytapur and Karwar. There are large natural oyster beds all along the coast in the creeks and backwaters.

In Bombay and its neighbourhood, oysters are collected in large numbers by the local fishermen from various natural oyster beds, situated along the coast and transplanted to Mahim and Satpati (Palghar) where they are cultivated on a large scale. The oysters are also sent out to mofussil towns after satisfying Bombay demands.

There is a great demand for oysters in Bombay, and the oysters are sent to the city from many of these coastal towns, but the trade suffers because there is no regular and definite supply. Many thousands of good oysters may be made available if some proper distributing agency was formed in Bombay. The oysters from the local creeks are large and good-flavoured. In the fair season the oyster supply could be arranged regularly since the steamers ply between Bombay and Goa, touching daily at some of the oyster-producing coastal towns to the south of Bombay.

Thousands of shelled oysters are despatched to clubs, hotels and private individuals in Bombay and outside. The local demand varies from 1,000 to 2,000 dozens of oysters per month. Many more thousand dozens would be sold if scientific methods were followed. At present there is a suspicion among the public that enteric fevers are caused by oysters. During the whole season 3,000 to 6,000 dozens are fished in Bombay and Salsette Islands. The price varies from annas 8 to 12 per dozen. The total earning from all the oyster farms in Bombay and Salsette Islands is approximately Rs. 2,000 to 3,000 per annum. As to the number of people employed in the industry it is not easy to give exact figures, since no licences are issued to men engaged in the oyster industry. Approximately there may be 5,000 to 7,000 people who are engaged in the oyster industry all along the Bombay coast.

Fishing Season. The oysters are fished from November to March when they become plump and white and are in a good marketable condition.

Fishing from the farms ceases between March and October as oysters are not in demand in the off-season. Moreover they are not fit for the market during the spawning season (March to May), while they are in a poor condition, and their soft parts are watery during the monsoon (June to October).

Methods of collection. The oyster farms are exposed at full low tide. Oysters which are found below the low-tide mark are collected by diving. The shells are removed from the beds by means of an instrument locally called *Koodal*.

After collecting, the shells are opened by breaking them and the soft parts are scooped out by means of an 'Oyster Knife.' They are stored in an earthen pot containing sea water and their soft parts are sold in the market. Sometimes, to save freight and ensure proper icing, the soft parts of the oysters are packed in tins before they are despatched.

By-products. The empty shells of oysters are used for making lime. They are crushed and put in a kiln, where they are burnt. The burnt fragments are then powdered. This product is much valued because it makes an excellent lime for building purposes. The empty shells are rather cheap and are sold at the rate of four to six annas a maund. Large quantities of oyster and clam shells are

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exported from the southern creeks to the different towns along the Bombay coast after satisfying the local demands. The following statement will give some idea of the export of oyster shells to Goa.

Statement showing the yearly exports of Oyster shell to Goa from the port of Tadri for the years from 1915-16 to 1920-21.

Year	Quantity of Oyster shells exported			REMARKS
	Tons	Cwt.	Qr.	
1915-16	1,043	10	...	<i>Note.</i> —No imports of Chunnam from Goa during the said period.
1916-17	718	10	...	
1917-18	637	...	...
1918-19	1,434	7	...	
1919-20	1,037	10	...	
1920-21	135	...	...

PRESENT METHOD OF OYSTER CULTURE

1. *Oyster farms.* None of the western methods of farming oysters are employed in this part of the country. It is not known definitely when the oysters began to be farmed in the different creeks (Mahim, Satpati, Palgarh, etc). There are many such farms round about the Islands of Bombay and Salsette, but the Mahim and Satpati farms seem to be the most prosperous. The oysters found there are large, well-shaped, and in excellent condition. The area of the various farms is small. All of them are well above the line of the low tide. The ground selected for farming is hard. It is composed of clay and sand covered over with a thin layer of mud.

The method employed at present at Mahim and other farms is as follows—

Young oysters, more or less an inch in diameter, are collected from the open sea and other exposed places. They are then planted in certain selected spots which are easily accessible in all tide conditions. These transplanted oysters are generally cleaned once or twice a month at the low tide and replanted in order to prevent mortality from various enemies. Under these conditions they grow rapidly, and within three or four years they measure about four to six inches in diameter.

2. *Cultch.* No attempt has yet been made by fishermen on our coast to employ a suitable cultch for rearing oysters. The spats are found on the natural cultch in the form of shells of oysters, dead or living, or stray pieces of stones, bricks, tiles, etc. The putting out of the cultch marks the highest stage yet attained in oyster culture, and different methods of distributing cultch are employed in different countries. At Arachan (France), tiles covered with a thin layer of lime mixed with sand are used as cultch, while in Japan, bamboo sticks are employed for the same purpose. In India we can

as easily make use of mangrove branches and the shells of oysters and other bivalves as cultch as they are cheap and easily obtainable wherever oyster beds are found..

CAUSES FOR THE DEPLETION OF THE OYSTER BEDS

(1) Immense harm has been done to the oyster beds by over-fishing. In some cases, oyster beds which were known to produce excellent oysters, have been destroyed completely. More oysters are fished every year from the natural oyster beds than the oysters produced from the farms. That is, the number of oysters fished in a certain locality are more than the young ones annually produced in that locality.

(2) Sometimes the oyster clumps are taken from these natural beds, to some convenient place near the high-tide mark and the well-grown specimens are separated over there; but the young oysters removed from the beds, are never replaced on the natural beds or transported to the farms, and die of exposure on the shore. There is a great waste all along the coast because of this practice among the ignorant fishermen.

(3) No close seasons are kept, that is the oysters are fished by the poor fishermen all the year round.

THE OYSTER INDUSTRY IN FOREIGN COUNTRIES

During recent years the study of oysters and the oyster industry have made a great advance in the western countries.

Europe and North America are the great homes of the oyster industry. There are great oyster farms in France, Great Britain and U.S.A.

The value of the world's oyster crop of marketable oysters in 1923 was estimated approximately as \$20,000,000.

The production of England and Wales (in 1916) was 31 million oysters (value £207,909). The total production of market oysters in U.S.A. according to the statistics of U.S. Bureau of Fisheries was 17,176,163 bushels with a value of \$12,618,135. France produced oysters worth 27,000,000 francs in 1912.

The world's Oyster production according to statistics from the 'British Encyclopædia' (1930) is as follows:—

Country	Year	Quantity	Value
U. S. A.	1925	20,000,000 bushels ...	\$ 14,000,000
Canada	1926	2,255 ,, ...	\$ 152,073
England and Wales	1926	15,857,900 ,, ...	£ 150,757
Fal Estuary	1926	2,500,000 ,, ...	£ 8,750
Japan	1924	2,032,744 kwam ...	Yen 616,713
		(Kwam = 8.27 pounds)	

SUGGESTIONS FOR IMPROVEMENT OF THE OYSTER INDUSTRY ON THE BOMBAY COAST.

In our country the oyster industry has been completely neglected and there is a great field for its development, as little has been done so far to take the full advantage of the rich harvest of the sea.

The natural oyster beds which extend over large tracts along the coast with an approximate area of 2,000 acres could be easily made to yield a much higher revenue than under present conditions. Those engaged in the industry do not know the value of farming oysters on scientific principles. The selection of the ground, the specific gravity and the temperature of the sea water, the oyster food in the locality, the necessary conditions for reproduction, their life history habitat, tides, currents of water, the grounds and the time and method of distributing the cultch, are all subjects which require investigation. Expenditure on such investigation would be amply repaid by the greatly increased supply. The oyster is very prolific for it produces millions of eggs in one season, but comparatively small numbers reach maturity. On our coast all oyster beds are above the lowest tide lines, and the oyster-farming can be developed on our shores in a few localities. In the beginning there may be failures, disappointments, but in the long run scientific cultural methods must succeed. The annual production of marketable oysters along the Bombay coast may be approximately 200,000 dozens with a value of Rs. 50,000.

It is time that our energies were directed to the greater production of the best and the cheapest food on our coast. It is possible, while working on such scientific lines as may suit local conditions, to convert the barren and unproductive shallow waters into rich and productive lands.

Difficulties in applying foreign methods of culture:—Foreign methods of oyster culture on our shore are not possible for the present, for the following reasons.

1. Poor fishermen.—They cannot afford to employ the expensive and complicated methods employed in western countries.
2. The fishermen are not educated, and are conservative by nature. They will not readily practise these methods even if they are demonstrated.
3. Moreover, no large profits are now expected from the oyster trade, while they get good returns in other fisheries (our waters are very rich in edible fishes).

As a matter of fact, we can also produce fine, large oysters. There are many factors which make oyster culture easier in our country than any other country. The following few points may be mentioned:—

- (1) Rapid rate of growth of our oyster.
- (2) Waters are less muddy.
- (3) There are many very good creeks which are known for the excellence of their oysters.

- (4) Cheap spat collectors (shells, etc.).
- (5) Few natural enemies.

A few notes on oyster culture of a simple and practical nature may, at this place appear opportune. They are included here with a view to helping agencies or individuals who have undertaken or propose to undertake oyster culture.

Before commencing oyster culture, it is necessary to prove that the waters are suitable for the proper setting of the brood, and that the conditions are fairly good for its development, growth, etc.

Oyster-farming :—The following conditions are necessary for successful breeding of oysters :—

(1) The ground must be sufficiently hard and clean for the spat. Millions of eggs that are emitted by the oyster never come to life at all, because the majority of them perish at the larval stage when they try to settle down, and only those survive which settle and lie on hard and clean surfaces.

(2) There should be no excessive variations in the salinity of the water (such as may be caused by floods or rains). The beds should not be exposed to extremes of temperature.

(3) Sufficient food for the oysters should be available (i.e., diatoms, spores and other microscopic animals and plants).

(4) Some suitable spat collectors should be employed (tiles covered with lime and sand, mangrove branches or shells, etc.) and nurseries constructed for young oysters.

(5) The beds should be protected from organic and inorganic enemies (star fishes, drilling molluscs, crabs, sand, mud, etc.).

(6) The tide conditions should be favourable (that is, the oyster beds should be exposed for some time under very low tide for cleaning and arranging the oysters on the beds).

(7) The young oysters and 'Seed oysters' should be saved from mud and other sediment by keeping them in boxes or rakes a few inches above the bottom of the bed. Simple and cheap boxes with trays can be used with wire-netting at the bottom and at the top, and these, if proper care is taken, will last for 10-15 years. After one or two years when the oysters are a good size, they should be removed to the oyster parks.

Improvement of Natural beds.—Oyster-farming can never be very extensive on the Bombay Coast, as large suitable grounds for oyster farms are not available. The natural oyster beds can however be easily made to yield more revenue than under the present conditions.

In order to encourage the industry in the Bombay Presidency, oyster-fishing in certain creeks and backwaters, which are now known to yield an excellent quantity of oysters should be controlled, to prevent overfishing. The Bombay Government should extend to other parts 'its Section 37 of Land Revenue Code (Bombay Act V of 1879) which exercises the rights of proprietorship over the oyster beds in the Sind Creeks.'

The following steps might be taken to put the Bombay oyster industry on a proper footing. It is interesting to note in this connection that some of the recommendations here made, i.e. (2), (3), (4), (7), were introduced by Mr. Walke in 1920, to replace and regulate the oyster beds at Tadrā (Kanara district), which were said to have been

THE SHELL-FISHERIES OF THE BOMBAY PRESIDENCY 843

destroyed by the fishermen. A few precautionary measures were adopted by the Superintendent of Fisheries to improve the oyster beds, and a prohibition order was enforced for the protection of these beds, but they were later cancelled, because the orders were not actually observed. The copies of the correspondence bearing on the subject of oyster beds in Tadri creek, and the operation and the effects of the orders prohibiting the removal of the oysters from the beds, with a detailed report from the Sirkarkun, Sanikatta are given in Appendix III.—

Recommendations—

- (1) Licensing of fishermen employed in oyster-fishing.
- (2) Observing a close season every year (March to May) when the oysters spawn.
- (3) By enforcing a long close season for some years in certain areas where natural beds have been badly depleted.
- (4) Forbidding the fishing of oysters under three inches.
- (5) Accurate information to the public regarding the edible oyster, its food value and the distributing agencies, etc.
- (6) A thorough survey of the oyster beds in different parts of the Presidency.
- (7) Introduction of artificial cultural methods where possible (only the practical, simpler methods may be tried).
- (8) Reclamation of depleted beds by artificial means :—
i.e. By restocking the old beds, i.e. by transplanting oysters.
- (9) Oyster parks as reserves at some suitable localities.
- (10) The fishing should be so arranged that the average number of adult oysters should not fall below the oysters fished or the oysters produced annually on the oyster beds. 'This it is not a matter of extending the close period, it is the control of the beds when open to fishing which is the essential to successful regulation.' (Hornell).
- (11) The establishment of one or two experimental oyster farms along the coast where different methods of culture may be tested under the supervision of a Superintendent with practical scientific knowledge of the subject.
- (12) Preservation of certain creeks for experimental purposes, as for example Jaytapur, Tardi, Satpati, Kalve and Navapur creeks, which are known to produce excellent oysters affords a good field for oyster culture for the following reasons :—
 - i. Extensive natural oyster beds are present in the creek, large area is available and can be increased if necessary.
 - ii. The bottom is hard and well suited for oyster culture. A large clean surface is available for the spat.
 - iii. Oyster cultch is available in large quantities (Shell-fishes i.e. Tapes, Meretrix, etc.) so that the bottom of the basin may be reclaimed and made hard and firm by a covering of shells.
 - iv. Seed is abundant.
 - v. Abundance of food material in the creek (diatoms, algal spores, etc.).
 - vi. Very few oyster enemies in the creek (star fishes, drilling mollusca, etc.).

vii. The oysters found in the creek are large and the growth is vigorous and they attain the marketable size in 2-3 years.

viii. The oyster beds are protected from the direct effects of open sea.

ix. The majority of the natural oyster beds are covered at half tide, and a large area in the creek is exposed during the spring tides, so that the cultural operations can be carried on during the ebb tide.

x. Sewage conditions are much better than in any other creek along the coast.

MINOR SHELL-FISH INDUSTRIES.

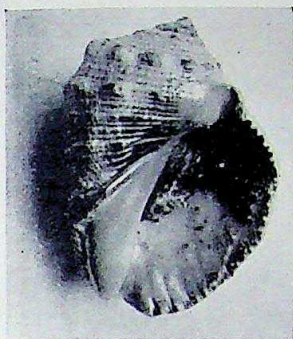
In addition to the above-mentioned true shell-fishes which are fished and consumed in large quantities, there are several other species occurring along the Bombay coast, which are not found in very large numbers to form a shell-fish industry, but the following forms are of local interest and are fished for local markets.

- | | |
|---------------------------------|---|
| (1) <i>Mytilus</i> (Sea-Mussel) | (9) <i>Pecten</i> (Comb-shell). |
| (2) <i>Cardium</i> (Cockles). | (10) <i>Solen</i> (Razor-shell). |
| (3) <i>Arca</i> „ | (11) <i>Placuna</i> (Window-pane Oyster). |
| (4) <i>Venus</i> „ | (12) <i>Purpura</i> (Whelks). |
| (5) <i>Dosina</i> „ | (13) <i>Natica</i> „ |
| (6) <i>Mactra</i> „ | (14) <i>Umboonium</i> „ |
| (7) <i>Circe</i> „ | (15) <i>Cypræa</i> (Cowries). |
| (8) <i>Donax</i> „ | |

BIVALVES.

1. *Mytilus* (Sea-Mussel).—This mussel, which is found along our coast, has a beautiful green colour. It is comparatively rare but its flesh is highly esteemed and considered as a delicacy by the fishermen. It grows from 5-6 inches in length and is found at Karachi, Bombay, Ratnagiri and Karwar. These mollusks form an excellent food but, as they are scarce and cannot be easily collected, they are seldom brought for sale in the market. They are a brackish-water form and generally found where the tidal streams are strong and water deep. They attach themselves to rocks and stones with a gelatinous secretion known as the byssus which is secreted by the byssogenous gland situated in the foot. Being gregarious in habit, they crowd in certain localities where they can be gathered in large numbers. They are also found in oyster clumps. In the deep waters *Mytilus* is collected by diving, and separated from the rocks by means of an iron chisel. It is only fished during the fair season, and at a very low tide.

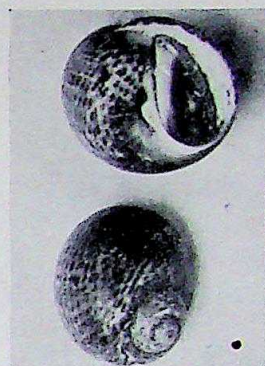
2. *Arca*. (Cockles).—One never meets this form very often and even then it occurs scattered on the shingle sandy flats. It occurs at Bombay, Alibag, Ratnagiri and Jaytapur. In size it seldom exceeds 5-6 cm. It attains marketable size in about two years. The flesh is coloured due to the coloured blood in this lamelli-branch.



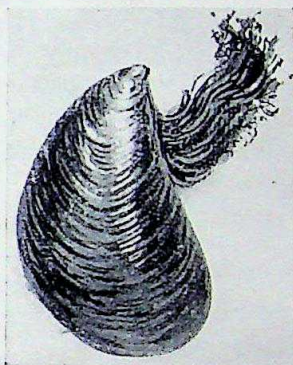
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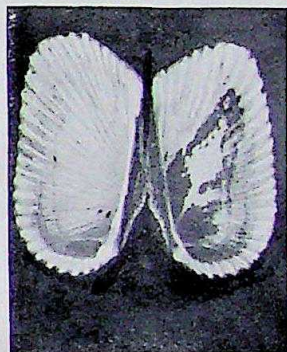
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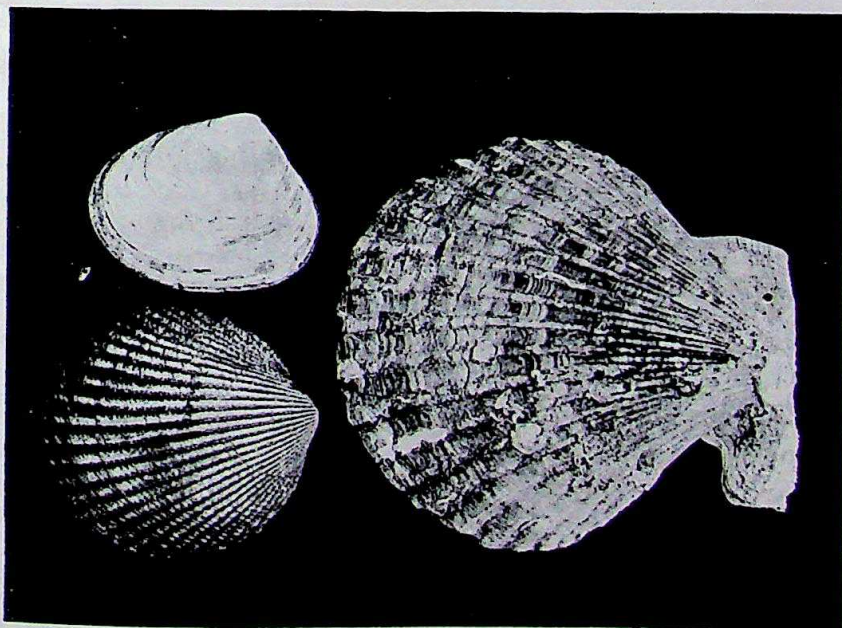
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6.



7.

1. *Purpura caruifera*. 2. *Umbonium vestiarius*. 3. *Natica ala papilionis*.
4. *Mytilus smaragdinus*. 5. *Dosina prostratus*. 6. *Arca inaequivalvis*
(Burg.). 7. *Pecten townsendi* (Sow) [right], *Cardium rugosum* (bottom left),
Tellina edentula (top left).

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3. *Cardium* is found in Karachi harbour on the muddy flats and is collected by the fishermen for their own use. It grows from 3-4 inches in length.

4. *Pecten* (Comb-shell) is rarely found alive on our shore. It is highly esteemed and considered as a delicacy by Europeans and is caught in large numbers in Europe and U. S. A. It is more a deep-water form. Its shells are found washed ashore, but no regular beds have been located along the Bombay coast. The shells collected from some localities measure 6-7 inches.

5. *Venus* is a common cockle in Bombay and along the southern creeks (Alibag, Ratnagiri and Jaytapur). It is found in fine sand, even when mixed with mud. It is almost circular in form and has a strong glossy white shell with fine concentric lines of growth. Fully-grown specimens measure about 3-4 cm.

Solen sp. (Razor-shell) lives in sandy tidal flats and is found from 6 inches to 2 feet deep in the sand. Its habitat is near the lowest tide mark, and it even extends into water which may be several fathoms deep. It buries itself very quickly with the help of its large and powerful muscular foot which is present at the anterior end of the body. A full-grown specimen is 3-4 inches in length. The semi-transparent shell is white, or yellowish white, in colour. The valves of the shell are long and narrow and gape at both ends. The empty shells are found on many sandy beaches washed ashore, but the living animal may be collected from Juhu (Bombay) and Jaytapur. In Jaytapur they are dug out in fairly large numbers for food purposes.

Placuna placenta (Window-pane Oyster) is found in hard mud in the creeks and backwaters. It is a brackish-water form. When young the valves of the shell are thin and almost transparent and the soft parts of the animal can be seen through it. As the animal grows old the valves become thicker and translucent. The shells are used as substitute for glass panes; hence the name Window-pane Oyster. The shells are also used for decorative purposes in gardens.

The pearls produced by this species are of inferior quality and low in value, because they are small in size, poor in lustre and wanting in hardness. Pearl-fishing along the Bombay coast is a minor industry. These Pearl oysters are found in three localities in the Karachi Harbour, on the Jamnagar Coast and in the Thana creek (Bombay). None of these beds are extensive. The true Pearl oyster (*Margaritifera sp.*) is not found along the Bombay coast.

The Sind beds (Karachi Harbour) have been practically destroyed due to overfishing. There is practically no pearl fishery along the Sind coast now. The beds are under the control of the Customs Department in Sind and they collect the royalty on the pearls fished along the Sind coast.

The fishery in Sind is of comparatively recent origin. It was discovered by the Mirs about 1836. Since the British Government took possession of Sind, the fishing of the banks has been leased by Government periodically for very variable amounts, ranging from the comparatively high figure of Rs. 6,205 in 1849 to as low as Rs. 617 per annum for a period of three years in 1904, a gradual diminution of revenue due without doubt to overfishing and the

financial impossibility of maintaining a supervising establishment adequate to enforce a proper regard for cultural safeguards' (Hornell, 1909).

On the Jamnagar coast the Window-pane oysters are of good quality and are fished in large numbers. The fishing is carried on under the supervision and control of the Jamnagar Durbar.

A small bed of these oysters is found in Thana Creek at Musi(?) but the fishery does not bring much revenue to the State.

Pearl oysters are found scattered in many other localities along the coast. But no regular beds are found in any other place along the Bombay coast. In Jaytapur they are collected by the poor shore-dwellers and are eaten along with the other shell-fish. But the flesh is not much liked because it is not so tasty.

GASTROPODS.

All the Gastropods found along the Bombay coast are of restricted use and purely of local importance. None seem to be used as food on a large scale and none of them are eaten on the Sind coast.

The following edible Gastropods are collected along the Bombay coast for food.

1. *Purpura* (Rock Whelk). It is found to a small extent along the Bombay and Konkan Coast, near the rocks and collected along with other shell-fish and cooked along with the rest. Its meat is extracted after being boiled for some time. It measures about 50-60 mm. in length.

2. *Umbonium*. Common at Malwan. During the months of March, April and May large quantities of them are sent to the markets. A beautiful Gastropod with many bright colour bands on the shells. Its size is very small, measuring about 10-12 mm. They are boiled in fresh water and the meat is extracted with a needle. The flesh which is very tasty is used either in curry or in soup.

3. *Natica* is another Gastropod which is collected in some southern creeks for food. It is found in the sandy beds along with the *Tapes* and *Meretrix* at Ratnagiri and Jaytapur creeks. It measures about 20-25 mm. The shell has short spirals with beautiful bright coloured spots. Its flesh is much liked by the fishermen and generally used in curry.

CEPHALOPODA. (Cuttlefish & Squids).

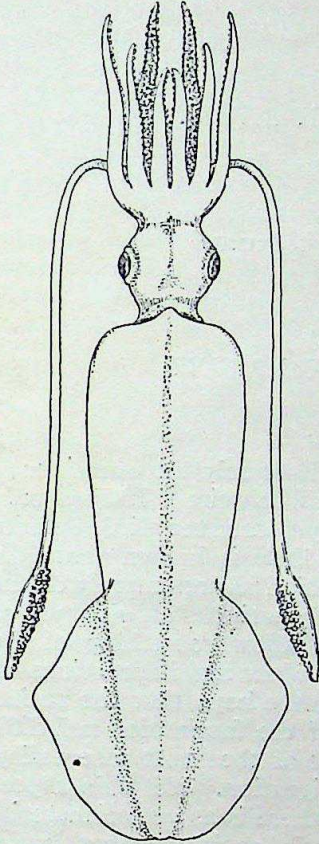
Only two cephalopods (*Loligo* and *Sepia*) are caught for food from November to May. They are sold in the market and have considerable economic importance on the West Coast. Considerable quantities of these molluscs are sun-dried but they are mostly sold fresh in the markets. They are highly esteemed by the Chinese and the Japanese and are considered a marine delicacy. The two most valuable and abundant forms are *Loligo* (squid) and the *Sepia* (cuttle fish). They are caught along with the other edible fish by the fishermen all along the coast.

1. The Common Squid (*Loligo sp.*). Squids are caught in large numbers along Sind coast and are sent to the Karachi market. They are also found in large numbers round about Bombay and are sent to the Bombay market. In Bombay the rates vary from annas

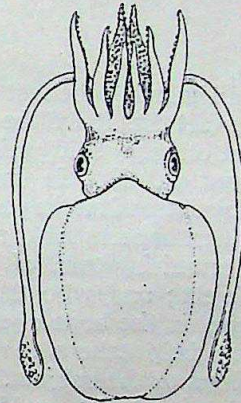
THE SHELL-FISHERIES OF THE BOMBAY PRESIDENCY 847

1-2 a dozen. When there is less demand they are sun-dried and sold eventually at about 2 annas a dozen.

2. Cuttle fish (*Sepia sp.*) The cuttle fish is valuable for its shell which is used in medicine as well as for polishing wood. Cuttle fish shells are often found washed ashore but not in such abundance as to form a local industry. In the adult condition they are usually 6-8 inches in length; they are liked much as food by the fishermen and are also used as bait. They are sold in the local markets, but the supply is not very regular. The market rate varies from 1-2 annas a dozen.



Loligo sp.



Sepia sp.

(To be continued)

THE STUDY OF INDIAN BIRDS.

BY

HUGH WHISTLER, F.Z.S., M.B.O.U.

PART X

(With 1 text-figure.)

(Continued from page 644 of Vol. XXXV.)

MIGRATION.

In starting the last article of this series I am only too conscious of the fact that it will be the most difficult of all to write. It is not only that one may study migration for years and yet learn very little definite about it. But in India, particularly, so little is known about the subject that it is impossible to write for Indian readers merely on the Indian aspects of the question. I can only write as an observer of an enquiring turn of mind who wants to know something of the subject; and who therefore sets down his ideas and impressions on paper in the hope of clarifying them and in the hope that the recital may help others to some appreciation of the fascination and difficulties of the subject. India should be one of the most interesting countries in the world to the student of migration. Yet this aspect of its bird life has been so neglected that there is as yet no material from which I can write on migration purely as it concerns India. I shall therefore try to summarise in general form the main aspects and principles of the subject—in their universal application—hoping perhaps that the recital may be of help to those who are in a position to study their local application. If my paper will turn any of our Indian naturalists to the study of migration, it will fulfil its purpose.

There are few aspects of Ornithology on which more has been written than migration. Up to a certain point we know a great deal on the subject. We know which birds migrate, at what seasons they come and go, what routes they follow and also a certain amount about their behaviour while migrating. Yet our exact knowledge stops at that point where the fundamental and most obvious questions arise. Ask yourself what the primary questions should be. I should answer and probably most of you would answer too—I want to know why birds migrate and how they find their way. Yet it is exactly these two questions which at present cannot be answered, though a great deal has been written in the endeavour to provide an answer. Answer these two questions and all our present exact knowledge would fit in round the answers as a mere elaboration of detail.

The starting point of most enquiries is usually definition. What is this migration which we seek to understand? My dictionary defines

migration as follows:—‘a change of abode: a removal from one country or climate to another; a number removing together’ and it goes on to define migratory animals as ‘animals that remove from one region to another as the seasons change’. Now these definitions do not quite serve our purpose, as a little reflection immediately shows. The Historians tell us of the migrations of the human race and more particularly of the mass movements of the Aryan stocks from an origin in central Asia. The Economist and the Politician tell us of the migration of Industry from north to south in England of to-day. The naturalist tells us of the migrations of the Lemmings in Northern Europe which end in wholesale destruction in the sea. The migrations of the Sandgrouse into the British Isles are a theme of the country chronicler. Yet all these movements are different from what the ornithologist has in mind when he speaks of migration. For he is thinking of a mass-movement which differs from those other mass-movements, even of the Sandgrouse, in one essential characteristic. Those movements may be huge and marked, yet they are irregular. No one can foresee them or count on them. There is usually a finality about them. They are an inundation which overflows a country. Its mark may be enduring or ephemeral but there is no rhythm of recoil. Bird migration on the other hand is one of the great rhythms of the world, a seasonal ebb and flow which moves as surely as the ebb and flow of the tides, the change of the seasons, the passage of day and night. We can confidently foretell that a thousand years hence the swallows will be migrating with the seasons as they were when the Prophet Jeremiah wrote ‘The Stork in the Heaven knoweth her appointed times and the Turtle and the Crane and the Swallow observe the time of their coming’. Our definition must be therefore more particular and run something like this:—the seasonal and rhythmic mass-movement of a large contingent of a species from its breeding ground to its winter quarters and back again. Migration in this sense is largely confined to birds. A few species in the other natural orders practise it, but in no other order is it so general and marked.

It is not strange that from a very early date man noticed the phenomenon. I am not well enough read in the Indian classics to know whether it was remarked on by the early Indian writers, but most of us know the earliest reference in the Bible. In the Book of Job we read ‘Doth the Hawk fly by thy wisdom and stretch her wings towards the south’. Homer and Hesiod mention the passage of the cranes, and Anacreon welcomes the return of the swallow to Greece. About 350 B.C. Aristotle actually discussed the question in a scientific spirit and it is evident that in these early days men appreciated the existence of the phenomenon and its problems.

What is more strange is to realise that in Mediæval Europe this accurate, if not extensive, knowledge was lost and was replaced by the most absurd theories. Even mediæval man could not fail to remark the presence or absence at certain seasons of common and conspicuous birds. Yet his explanations were extraordinarily crude. One theory was that the missing species retired to the moon; another suggested that birds changed their form. That the Turtle-Dove of summer became the Stock-Dove of winter, the Redstart became a

Brambling was I suppose the application of the theory if it was not even more fantastic in detail. But perhaps the most universally believed suggestion was that the missing birds hibernated in hollow trees and ponds. The accompanying figure shows a picture in a book by Olaus Magnus (Archbishop of Upsala about 1550) of



fishermen standing on the ice and drawing in a mixed catch of swallows and fish. This belief lingered on to a surprisingly late date. Even when men were prepared to believe that large birds did actually migrate—and anyone who had witnessed the passage of cranes could hardly refuse belief—they thought that small birds must travel on the backs of the large ones as passengers.

However, we must leave the realm of ignorance and come to the question of our present-day knowledge.

If any of my readers is now starting to study birds I would suggest that his first need is to shed a popular delusion. People who are not naturalists start with the idea that a bird is by reason of its possession of wings a very irresponsible and free creature. I think they commonly picture it as here to-day, gone to-morrow, moving on incessantly with no ties, except in the breeding season, sleeping wherever the fortune of the day's wanderings have taken it. This is very far from the truth.

The avifauna of India, or any square mile of it, is never stationary. Season by season and almost day by day it changes in response to the stimulus of migration, climate and food supply, but this change conceals an order and a staticness which is surprising. A bird is really very regular and tied in its habits and movements though the possession of wings and great mobility obscure the fact. A little observation soon shows that this is so. If you take the trouble to watch the birds within the immediate range of a short daily walk of your bungalow you will notice that a particular shrike is always haunting the same little clump of bushes. He has several favourite perches, on one of which you generally see him. If you disturb him he generally does much the same thing. If you chase him deliberately away he retreats only within a certain radius of his favourite spot. If you take the trouble to make sure that he leaves his little territory altogether, you will find him back there next time you return.

If your observation becomes more intense, you will find that he sleeps always in the same place and probably follows a very regular routine in his habits and movements in his little territory. The same with other birds. You realise that a particular bough is the favourite perch of a Black Redstart or a Red-breasted Flycatcher. With increasing interest and observation you learn that the mixed hunting party of warblers, creepers and tits which always seem to be on the travel are really only pursuing a constant round which day after day you will find them traversing. The Lugger Falcons on the church tower, the vultures that brood obscenely on a clump of peepul trees are really just as tied as the shrike and the flycatcher to their homes and habits. The falcon is larger and swifter, so his hunting ground is wider than the shrikes. The vulture may range ordinarily over a hundred square miles for his occasional gorge. The only difference between them all is that their territories and range vary according to their circumstances, and some have their habits more readily interfered with by the exigencies of their food supply. Circumstances permitting, the bird is as much a creature of home as we ourselves.

Once we have grasped the conception of a bird as a creature of a fixed home and habits, we are in a much better position to think of it as a migrant. But there are many stages in between the two states.

Biologists inform us that a new generation is always in wild nature, so far as circumstances allow, started in the ancestral home of the race. By this they mean that when the eel migrates from its inland river to the depths of the Atlantic to spawn, we must regard the ancestral call of the ocean origin of the eel as being stronger than its more modern adaptations to a fresh-water life. It is with this biological rule in the back of our minds and also for practical convenience that we usually consider a bird's breeding territory as its home. In considering migration we therefore start on the common ground (with all species and types of movement) of the breeding territory as the starting point. This must be borne in mind in the discussion that follows.

Now it is an axiom of all migrational studies that the breeding ground of a migratory species is, as a general rule, in the colder and therefore more northerly part of its complete distribution. Although not of universal application, this rule is so general that all theses on migration have necessarily to allow for that point in their explanations and we shall have to return to it later. In the meantime, we must consider the effect that migration has on the bird life and bird distribution of any given area.

The most extreme case of migration which could concern us in India and Ceylon would be that of species which nested within the Arctic Circle in Northern Siberia and wintered in the Island of Ceylon. This particular species would therefore obviously stand in very different relationships to the countries in the whole of its range from N. Siberia to Ceylon. In N. Siberia it will be a summer visitor only; but as this is its breeding ground or home a comparatively short residence of perhaps only three months of the whole year will be sufficient to mark it for all Zoo-geographers as a Palæarctic species and as such it will be considered by them in all

estimations of the faunas of the other countries that it visits. In a comparison between the Fauna of Ceylon and the Malay countries, for instance, it will be ruled out of the discussion as of little or no importance. In Ceylon the bird will be a winter visitor only.¹ In the countries between N. Siberia and Ceylon our bird will be a passage migrant, travelling through southwards in autumn and returning northwards in spring. Should it travel southwards by a westerly route and northwards by an easterly route or vice versa, it will be a spring passage migrant in one set of countries and an autumn passage migrant in another set. The condition however remains that wherever it is on autumn passage its direction will be ultimately north to south, and wherever it is on spring passage its direction will be ultimately south to north, however local conditions may temporarily obscure the point.

This is migration in its most extreme and obvious form for, as is usually stated, species which breed far to the north usually winter far to the south. But as we leave the extremes the position becomes more complicated. In the extreme north the summer visitor has little option but to migrate. It is for him the only method, in most cases, of answering the problem of winter. For one must never lose sight of the fact that all life in northern latitudes has as one of its major problems the question of conserving the species through the rigours of winter. This problem presses more hardly, the smaller and shorter-lived the species.

The short Siberian summer provides ideal conditions for most birds to breed and rear the new generation. Food is abundant, temperature is satisfactory, space and freedom for wild life are illimitable. With winter there is a most decisive change. In a dead world of snow and ice the myriad birds of the summer must die—or leave; and having wings they leave.

Further south, however, with more temperate conditions, the issue is not so clear-cut. There we find that migration takes on a fresh attribute and we are confronted with the phase known as partial migration, that is to say some members of a species leave and the remainder do not. Some individuals are resident, to express it differently and others are only summer visitors. This in turn may become still more complicated further south in the range of a species where, in addition to some individuals of a species being resident and others summer visitors, there may be others which are there as passage migrants or even winter visitors from further north in the range.

It may be as well to take a concrete example of this complicated state of affairs, and this is well afforded by that well-known species the Pied Bush-Chat (*Saxicola caprata*) in N.-W. India. Now in one district of the Punjab it is easily possible for this bird to be a summer visitor (as the majority undoubtedly are), a resident (as a small number of individuals are), a winter visitor and a passage migrant

¹ We may remark here in parenthesis that Ceylon being for all practical purposes the most southerly land in this section of the world, has no summer visitors. In other words all land birds breeding in Ceylon have to be residents as there is no land southwards for them to migrate to, fulfilling the condition of breeding in the north and wintering in the south of their distribution.

(as a certain number breed in Turkestan as summer visitors and pass southwards across the Himalayas in winter). A casual and inaccurate observer, especially if tied to that particular district and ignorant of the work of other observers, might there easily fall into the mistake of thinking the species a resident where in fact it fell into every class of migrant.

I will emphasise therefore, by recapitulation, that the first point in the study of migration is to realise that it must be considered always in terms of the following divisions, to all of which a particular species may belong in some phase of its movements as a migrant, viz.

- (a) Summer visitor.
- (b) Winter visitor.
- (c) Passage migrant with subdivisions (i) spring, (ii) autumn.
- (d) Partial migrant.
- (e) Vagrant.

This last division refers only to individuals which become lost on their migrations and turn out of their proper routes. It should not be used as a synonym merely for rarity on a normal passage route.

Side by side with migration, in whatever aspect of those subdivisions it may appear, we meet with another series of mass-movements which may be easily mistaken for migration. These movements are of several types of which the following may be suggested as examples, viz.—

- (a) Overflowing of a population which has for some reason become overcrowded.
- (b) Pursuit of a special and temporary food supply.
- (c) Response to certain weather conditions.
- (d) Local movements.

There is no need to elaborate examples of these movements, but it is well known that the passage of a flight of locusts is followed by a vast concourse of birds that feed on locusts; that early campaigns were accompanied by the shifting of the vulture population; and that an excess or failure of the monsoons has a great effect on bird distribution in India.

Movements of these types do not fulfil our primary definition of migration in the specialised sense. Such movements are irregular. There is no rhythm about them. They have not necessarily any connection with breeding. But I think they must be borne in mind by all who study migration as I think they help to throw light on the genesis of migration though this is not admitted by all writers.

The border line between true migration and these irregular mass-movements is at any rate very ill-defined. Local movement, for instance, is found in every shape and degree and at one end of the scale it certainly merges into the definition of true migration, albeit on a very small scale.

The simplest form of local movement can be illustrated in the case of the House Sparrow (*Passer domesticus*). In the breeding season this bird acts up to its name and chiefly frequents the houses in every village, breeding in pairs in every suitable place. As soon as the young are on the wing, which for the most part coincides with the ripening of the autumn crops, sparrows leave the villages in great

numbers and gather in flocks in the fields. Their movements are then quite erratic and depend on a food supply of ripening grain. This may entail extensive movement, in different directions in different years. Local movement of this type also occurs commonly on a very small scale, as when the Wren-Warbler (*Prinia inornata*) moves literally from field to field in response to the crops which give it cover for its unobtrusive life. A plot of sugarcane may house a hundred wren-warblers, which perforce have to move when that field lies fallow after the cane is cut. Movements of this type readily tend to become regular. In so many district lists one reads statements to this effect :—'This species is common in the station except during the breeding season when it retires to the neighbouring jungles.' A local movement has become standardised and, in fact though not regular, satisfies our definition of migration.

We must not overlook, either, the definite seasonal movements connected with the Himalayas (and other big ranges in other parts of the world of course). Here we have alpine conditions conforming to Arctic conditions, as they do in many other respects. Throughout the length and breadth of the Himalayas there is a vast area, roughly speaking all altitudes above 8,000 ft. and below the region of perpetual snow, which is similar to N. Siberia which we have spoken of above. In summer it is a temperate zone, rich in plant and insect life and able to support a huge population of birds. In winter snow and frost cut off the greater part of this food supply and a large proportion of the summer bird population could find no living there. A number of the species definitely migrate and we speak of them normally as migrants. There is however another batch of species which are commonly spoken of as residents in the Himalayas, though in actual fact their movements are almost as regular. The Blue-fronted Redstart (*Phenicurus frontalis*) may serve as an example. This bird breeds in the upper zone of the forests and the lower zone of the Alpine pastures, roughly speaking 10,000 ft. to 13,000 ft. in altitude, under what in summer are most favourable conditions. In this zone in winter it cannot find sufficient food; so as the autumn frosts and snows begin, it gradually moves downhill before them, its zone in winter therefore varying in proportion to that winter's climatic conditions. As the grip of winter again loosens, it moves upwards and in due course finds its breeding zone habitable. The degree of this movement is variable, but under its influence some species in some years wander a considerable distance into the sub-Himalayan plains.

Mention must also be made of another type of local movement which helps to illustrate the strong hold which home association has for a bird, and the readiness with which a bird comes under the sway of rhythmic movement. It is particularly marked—or at any rate best observed—in the crow family. The common House Crow, for instance, sleeps in vast colonies of many thousand individuals. This dormitory is used by birds from a tremendous distance around. For an hour or so before dusk great columns of crows converge from all points of the compass, leaving again in similar columns before sunrise. Now the distance that crows travel in this manner is very great. A good account of this daily flight to a dormitory at Lahore

is given by the Rev. T. Bomford (*J.B.N.H.S.*, xviii, 904) and he had reason to think that the main columns came from well over 30 miles away. In Kashmir I noticed similar columns of Jackdaws (*Corvus monedula*) at Baramullah which were evidently travelling to the dormitory in Srinagar.

Without devoting more space to these various types of movement, I think enough has been said to suggest that there is plenty of reason why many birds should migrate and there are plenty of factors in their lives from which the habit of migration might easily develop. But the difficulty is always to explain why migration in its complete form should have become the compelling and regular force that it undoubtedly is. While it is easy to see that the Blue-throat nesting up in the wastes of N. Siberia must leave that country before the approach of winter, it is not so easy to see why it must or does return the following spring. India and Ceylon contain conditions of country which suit its nesting requirements. They afford an ample supply of food in all seasons of the year. Between the plains and the highest Himalayas there is a range of temperature and climate which somewhere or other must suit the species, yet the true migrant is evidently in the grip of a compelling force. Conditions of food and security, humidity and temperature may still be the same as those that served it a few weeks before. They may serve for the breeding needs of closely allied forms which stay behind. Yet, year after year with a regularity, sometimes almost to the day, the species leaves the peace and plenty of the south and starts the dangerous and laborious journey northwards. That it should start at all seems strange, that it ever arrives at the appointed place miraculous.

What is the nature of the stimulus that starts the bird off? Various factors have been pressed into service by different writers, of which food supply and temperature seem *prima facie* the most likely. But all suggested factors are variable in their incidence while regularity is a basic characteristic of migration. There is therefore much that is attractive about Professor Rowan's recent suggestion that the explanation of the regular rhythm is to be found in day length.

Day length is now recognised as of vital importance to all creatures whose activities are directly or indirectly influenced by sunlight. Professor Rowan claims to have established that the reproductive organs of a bird are directly affected by day length. By artificially manipulating the amount of light to which a bird is exposed, the interstitial tissue of the reproductive organs may be brought into any desired stage of development. It can be advanced or retarded as compared with other individuals of the species subject to normal conditions. The hormone produced by this tissue controls sexual behaviour and migration can therefore be considered as a definite phase of reproduction, linked to it.

Professor Rowan's experiments also produced valuable circumstantial evidence. On the one hand he kept migratory species under normal conditions until winter and then released them after the tissue changes were complete. These birds did not migrate as the stimulus had then apparently passed. Other birds were kept until mid-winter under artificial conditions of light sufficient to produce a premature increase in the tissues, equivalent to that of the spring

season. These birds when liberated in mid-winter disappeared at once and some of them were actually recorded as moving northwards, that is in the direction of the spring migration.

The explanation of migration suggested by these experiments is then as follows. The rhythm of the waxing and waning of the year, working through quantity of daylight hours, which control physical activity, induces a corresponding rhythm in the reproductive system. Under its urge in spring the migrant bird seeks out its ancestral home to breed. The return journey is in the nature of reflex action, the contrary swing of the pendulum. It is reinforced by the age-long threat of natural selection that the bird which does not leave will perish, a threat that is in the background for all that the conditions of the moment hold no hint of urgency.

If this explanation is accepted, one has still a difficulty about the young birds. Do their undeveloped organs reflect the adult changes and do they so connect up with the first revolution of the rhythm of nature, involuntarily as they undergo their first post-juvenal moult? Are they influenced by mass suggestion, the uneasiness of the adult hordes around them? We know very little about the order of the departure of old and young.

The second great question to answer is how birds find their way on migration. Several theories have attempted to answer this question. One writer suggests that the birds travel by a series of landmarks, known personally to all the older generations in the migrating hosts. Another suggests a cumulative inheritance of the result of experience, and many changes are rung on these suggestions.

The first point in any consideration of the question seems to be to understand the conditions under which birds travel. These are best viewed under four main headings:—

- (a) In what manner do birds travel?
- (b) At what altitude do birds travel?
- (c) At what pace do birds travel?
- (d) Does migration follow any defined routes?

The first three of these questions are evidently concerned with each other, as the height at which a bird flies, the pace at which it travels and the manner it adopts will clearly differ not only according to species but also to circumstances. Theoretically a bird travelling between two points on the map may perform the journey in one of two ways. It may start on the wing from one point and fly without intermission direct to the other point; or it may travel in a series of laps. Should the first method be adopted a fast flight high in the air would seem to be the obvious corollary. If it flies in a series of laps these may theoretically vary from a small series of high fast flights, to a long series of daily journeys performed at ease and combined with feeding. In actual fact there is probably complete gradation between the two theoretical methods.

In India the Mongolian Sand-Plover (*Charadrius mongolus*) evidently furnishes a good example of a bird which apparently migrates from its winter quarters to its breeding ground in one lap. Ticehurst (*Ibis*, 1923, p. 658) has given an interesting account of this species in its winter quarters on the mudflats of Karachi where it is the commonest wader and delays so long in its departure that the

courtship may be viewed on the Karachi sands. The organs also reach full breeding size at Karachi a point unusual in migrants in their winter quarters. These birds breed on the high wastes of Ladakh and Tibet. Yet, in spite of their abundance and the amount of terrain apparently suitable for them in the great Indo-Gangetic plain, they are unknown to occur anywhere between Karachi and Ladakh. The inference is irresistible that they perform the journey in one lap. They must fly high to escape observation and also to cross the Himalayan ranges. They must fly fast to get through with the journey.

At the other end of the scale some small Passerine birds evidently travel very slowly, moving in waves that pass on day by day and night by night. A good example of this type of movement is afforded by the Tree-Pipit (*Anthus trivialis*) which swarms over the Punjab during migration in flocks which will be found feeding everywhere and which on the outer slopes of the Himalayas I have seen travelling up the hillsides in an irregular stream.

We shall probably not be far wrong in thinking that the height at which a bird flies is connected with two points, the length of the laps in which it ordinarily travels and the atmospheric and climatic conditions of the particular day. Other things being equal, large birds doubtless as a rule travel higher than small birds. That birds sometimes travel low over the face of the sea, is easily verified by all who travel in ships. The maximum height scientifically established for a small bird on migration is 2,200 metres above the nearest ground. There are however only a few records over 1,000 metres and comparatively few between 400 and 1,000 metres. The great majority of migrants journey at an altitude below 400 metres.¹

There has been much exaggeration as to the rate at which migrants travel in direct flight. Estimates of 100 to 200 miles an hour have even been provided for some species. Modern critical work on this subject suggests that the average rate of travel of a medium-sized migrant is much more likely to be in the neighbourhood of 30 or 40 miles an hour.

It is difficult to give a short answer to the question whether migration follows any particular route. Some writers, to use Professor Newton's caustic remark, attach an almost superstitious importance to the phrase migration-route. They envisage a map of the world on which is drawn a series of great routes from the north to the south fed by a regular net-work of subsidiary tracks. Their idea is roughly that the routes exist, due in their origin to river systems, seas and mountains and that the migrants are drawn to travel along them, just as the human traveller naturally follows the road and rail system of his country. It seems however much more probable that each migrant species goes its own particular way and that a supposed migration route is only the coincidence of the ways taken by a number of species. Too often only, as well, it marks only the activities of a particular observer.

It seems obvious that if a particular species breeds in Turkestan and winters in Africa, there must be some choice of routes

¹ See F. von Lucanus, *Die Ratsel des Vogelzyges* (1921).

between the two places and that one route possesses advantages for that species over the others, while it is easy to understand that one route may be better for the autumn journey southwards and another for the return journey in spring. It is also easy to see that the comparative advantages between the possible routes may vary according to the requirements of the different species that require to make the journey. But against factors like this, which seem to tend to narrow the line of migration, one must set the fact that migrants undoubtedly travel not in column but over a tremendously wide front. Whilst one must also remember that the route of an air-borne traveller is necessarily much less definite than that of a traveller by land. This point has been very well brought out in a book entitled *This Bondage* written by Commander Acland (1929), which should be read by all who are interested in the subject. Commander Acland is no ornithologist, but he is an airman who wishes to make the students of migration familiar with the rules of travel in that moving medium, the air.

For us the chief interest of the book lies in the insistence on the difference between ground and air travel. If *A* and *B* are two places one hundred miles apart on a direct route, the traveller by ground knows in advance the exact mileage which he has to travel. It remains the same for one journey or a dozen. The traveller by air has no such knowledge. Were he to fly from *A* to *B* in a vacuum low above the earth he could say for certain that his journey would take a hundred miles. But instead of in a vacuum he travels in a moving medium, the air. His air mileage is therefore usually entirely different from his ground mileage and also varies almost every time he performs the journey, for he is at the mercy of those currents of air which we call the wind. If he flies with the wind, his air mileage is reduced; if he flies against it, his air mileage is lengthened. If the wind comes from one side or another his course becomes a segment of a circle, greater or less according to the angle and velocity of the wind and the rate of his own speed. It therefore is easily possible that in twenty journeys between *A* and *B* he may never actually fly the same course in relation to the ground below. The greater the distance between *A* and *B*, the greater possibility of variations in the courses flown and the less chance that migrating birds can travel by a series of usual landmarks.

I do not see how, in the present state of our knowledge, we can get away from the supposition that migrants travel to their destination under the influence of some directional sense which is roughly speaking of the nature of the magnetic compass. Very often no doubt the bird unconsciously follows a definite route with a definite series of customary halting places on it just as the human caravan across central Asia travels by a series of known stages. Under the influence of the sexual impulse the bird would fain return to its home, its breeding place. It starts on the journey. It makes for the old established stages, each in turn, till it arrives at its destination. It does not know why it is travelling. It is ignorant of its route or why it goes by that particular route. It travels only by the compass of the unknown sixth directional sense, following the route dictated by the past history of its species in the growth of its migrations.

This may seem fanciful but I see no reason why it should not be correct. The rudiments or the remains of such a directional sense are undoubtedly present in many human beings. I personally have always felt in forest or in unknown country a sense of direction guiding me roughly in the way I wanted to go. This is a small point but we have more definite evidence such as the classic case of the Noddies and Sooty Terns of Bird Key. This is an island of the Tortugas group which marks the northern limit of the migrations of these species. Breeding birds were caught on Bird Key and marked. They were then taken in closed baskets by steamer to Galveston in Texas more than 800 miles away over seas which the birds had probably never traversed in their lives. Some returned in six days, others took longer and some never returned at all. Further experiments of a similar nature were made, varying in detail, and in all of them a satisfactory proportion of the birds returned to their nests. The actual details of the experiments are worth study but there seems no doubt that it was clearly proved that untrained birds could return successfully from a distance of 800 to a 1,000 miles over the apparently trackless sea. The supposition that they were guided by some such sense as I have postulated, seems easier than any other possible suggestion as to the manner of their return.

I should like to have ended this chapter by a brief account of the chief directions in which the stream of migration travels over India between the Himalayas and Ceylon. But the long and short of it is that the material does not yet exist which would allow such an account to be written. After collating all the records in India of a great number of species and plotting the result on maps I have come to the conclusion that it is not yet possible to write an accurate account of the movements of any of our Indian migrants. The number of observers has been too small. The blank spaces on my maps too often represent not the absence of the species but merely only the absence of an observer. There is one exception only. We have a very fair knowledge of a stream of migration which passes through the N.-W. Frontier Province, the Punjab and Sindh as it has been recorded in numerous papers in the *Journal* of the Bombay Natural History Society and the *Ibis*. This exists as a nucleus which we may hope, will be gradually extended by observations in other parts of India. For it is already clear that each species has fairly defined routes in India and they are worth investigation and record. In Europe and Asia a great deal has been learnt during the present century by the practice of 'ringing' birds. This system is very simple in theory but depends in practice on the collaboration of a large number of 'ringers' and on the general good will and interest of the public. Success depends on the handling of as many individual birds as possible, whether as adults or as young in the nest. A light aluminium ring is placed on one leg of the bird. On it is engraved an individual serial number and the address to which the recovery of the ringed bird is to be intimated. A record is kept of all rings and numbers of the species ringed and of the date and place where the bird was ringed. The recovery of a bird bearing one of these rings immediately supplies an isolated but authentic fact regarding the movement of an individual bird. To quote an instance from a recent

Journal (vol. xxxv, p. 457), a Rosy Pastor (*Pastor roseus*) was shot at Lahore, Punjab on 28 April 1926. It bore a ring number 27381 of the Royal Hungarian Institute of Ornithology which was forwarded to the address given on the ring. It was established at the bureau that this particular Pastor was ringed as a nestling in N.-E. Hungary on 30 June 1925. The direct air distance between these two places is 3,000 miles and we are at once in possession of certain absolutely authentic facts—worth any amount of theories—regarding the migration of the Rosy Pastor. As such recoveries multiply, our knowledge increases. Certain very definite facts are already beginning to emerge regarding the migrational movements of the British Isles from the accumulation of these records, and now that the practice of ringing is in full swing, the records grow in number and so in value.

A NEW GENTIAN FROM N. WAZIRISTAN.

BY

E. BLATTER, S.J., Ph.D., F.L.S.

*Gentiana Lowndesii*¹ Blatter, *spec. nov.*

[*Gentianaceae pertinens ad sectionem Pneumonanthe Neck. Caules simplices vel ramosi internodiis brevibus ad 2.5 cm. longis ad 11 cm. alti. Folia radicalia lineari-oblonga apice subobtusata, coriacea, ad 4 cm. longa, 8 mm. lata 1-nervosa, caulina vero lineari-subspathulata, apice acuta, basi connata tubum brevem formantia. Flores usque ad 4 numerantes axillares et terminales, 1-2 pedicellati in axillis superioribus. Calycis tubus ad 1.5 cm. longus, non carinatus; lobi 5, subæquales, lineares, acuti, 6-9 mm. longi. Corolla cyanea, 4.5 cm. longa, ad dentes ca. 2 cm. lata, plicis aucta tubo 3-3.5 cm. longo, lobis 5 subæqualibus, usque ad 1 cm. longis et basi 5-8 mm. latis, triangulari-lanceolatis vel ovalis, acuminalis vel cuspidatis. Stamina 5, libera, inclusa, in fructu immaturo persistentia; filamenta applanata, parte $\frac{3}{4}$ inferiore multo largiore ca. 2 mm. lata. Ovarium 1-loculare, stylo brevissimo, stigmatibus linearibus demum revolutis 3-4 mm. longis. Capsula ad 3 cm. longa, 5 mm. lata pedicello 1 cm. longo; semina non visa.]*

Rootstock stout, perennial. Flowering stems simple or branched up to 11 cm. high. Internodes of stem short, up to 2.5 cm. long, purplish. Radical leaves forming a dense cluster, linear-oblong, leathery, up to 4 cm. long by 8 mm., subobtusate at the apex, 1-nerved. Cauline leaves up to 3 cm. by 3-4 mm., linear-subspathulate, acute, glabrous, united at the base, forming a short tube about 5-7 mm. long. Flowers up to 4 on each plant, bell-shaped, terminal and axillary, 1-2 stalked in the upper axils. Calyx-tube up to 1.5 cm., not keeled. Lobes 5, linear, acute, subequal, 6-9 mm. long, united up to end of tube by scarious tissue. Corolla sky blue, 4.5 cm. long, 2 cm. broad; tube 3-3.5 cm. long. Lobes 5, subequal, up to 1 cm. long, 5-8 mm. broad at the base; triangular-lanceolate or ovate, acuminate or cuspidate, folds between the lobes, throat milky-white-dotted. Stamens 5, free, included, persistent in young fruit; filaments flattened throughout, lower $\frac{3}{4}$ much broader measuring about 2 mm. in diam., anthers large, 4 mm. long. Ovary 1-celled; style very short, stigmas linear, curved outwards, crozier-shaped, 3-4 mm. long. Capsule up to 3 cm. long, 5 mm. broad, stalk about 1 cm. long. Seeds not seen.

Note: This species is related to *G. Kurroo* Royle and *G. decumbens* Linn. f. From the former it can be distinguished by the branched stem, the shape of the corolla-lobes and the much larger capsule. It differs from *G. decumbens* by the stem being branched, by the calyx-lobes not being very unequal, by the corolla-lobes not being rounded and by the flowers being stalked.

Loc.: N. Waziristan: Alexandra Ridge, 7,800 ft. (Capt. D. G. Lowndes No. 2430, type).—Flowered in October 1931. This species is found plentifully on open hill-tops, 7,500-8,500 ft.

¹ After Capt. D. G. Lowndes who found this plant.

ON A COLLECTION OF GROUND BEETLES (CARABIDAE) FROM WAZIRISTAN.

BY

H. E. ANDREWES.

In the spring of 1930 (March and April) an Excursion, organized by St. Xavier's College, Bombay, under the direction of the Rev. Dr. G. Palacios, visited the little-known region of Waziristan. The Carabidae found there were sent, with other insects, to the British Museum, and I have been asked to give some account of them. Twenty-one species are included in the collection, and all but one of these are referred to below; a solitary specimen of a *Lebia*, unknown to me, is in such poor condition that I cannot deal with it here. Of the remaining twenty species two are confined, so far as I am aware, to eastern Central Asia, twelve are found in the Himalayan region of North India, and six are new. An enumeration of the species follows, after which will be found the descriptions of the new ones; the type specimens of the latter will be placed in the British Museum.

1. *Calosoma maderae* F. Syst. Ent. 1775, p. 237 var. *auropunctatum* Herbst in Arch. Ins.—gesch. (Fuessly). v. 1784, p. 131; Andr. Faun. Brit. Ind. Carab. i. 1929, pp. 51 and 58.

1 Ex. Both the type-form and the variety are widely spread through the palaearctic region; the former has not yet been found in India, but the latter is common in the North-West.

2. *Scarites granulatus* Andr. Faun. Brit. Ind. Carab. i. 1929. pp. 231 and 256.

1 Ex. I have previously seen only two examples of this species, one from Pusa, the other found in Bengal on the banks of the Brahmaputra River. In the specimen from Waziristan the head is more coarsely striate than in the type.

3. *Scarites limilaneus* sp. n. (See p. 863).

4. *Bembidion insidiosum* Solsky in Fedchenko's Reise in Turkestan ii. pt. v. 1874, p. 130. Razmak.

1 Ex. I have not seen the type, but the example agrees with a specimen from Bucharra in my collection; the species is not at present known from India.

5. *Bembidion waziristanum* sp. n. (See p. 863).

6. *Bembidion palaciosi* sp. n. (See p. 864).

7. *Tachys tetraspilus* Solsky in Fedchenko's Reise in Turkestan ii. pt. v. 1874, p. 114; Andr. Revision of the Oriental species of the genus *Tachys*, Ann. Mus. Civ. Gen. li. 1925, pp. 404 and 433.

3 Ex. Found both in Central Asia and North India.

8. *Chlaenius hamifer* Chaud., Bull. Mosc. 1856. ii, p. 209.

1 Ex. Very common throughout South-East Asia.

9. *Chlaenius lederi* Reitt., Deutsch. Ent. Zeitschr. 1888, p. 417.

1 Ex. A Central Asian species not hitherto met with in India.

10. *Chlaenius tenuelimbatus* Ball., Bull. Mosc. 1870. ii, p. 326.

3 Ex. The species is known from Central Asia and Kashmir.

11. *Licinus corus* sp. n. (See p. 864).

12. *Acinopus laevigatus* Mén., Cat. rais. 1832, p. 128.

1 Ex. A fairly common insect, met with in Central Asia, Persia, and Kashmir.

13. *Harpalus melaneus* Bates, Proc. Zool. Soc. Lond. 1878, p. 714; id., Scientific Results of the Second Yarkand Mission, Col. 1891, p. 6, t. 1. f. 4.

Razmak, 1 Ex. Common throughout the western half of the Himalayan tract. In the Waziristan example the puncturation of the prothorax is very much reduced, but Dr. Schauburger informs me that he has in his collection

ON A COLLECTION OF CARABIDAE FROM WAZIRISTAN 863

specimens from the Chinese Province of Szechuen, in which this character is a very variable one.

14. *Harpalus confinalis* sp. n. (see p. 865).
15. *Anara (Leiocnemis) himalaica* Bates, Proc. Zool. Soc. Lond. 1878, p. 716, id.; Scientific Results of the Second Yarkand Mission, Col. 1891, p. 14.
Razmak, 4 Ex., varying somewhat in their characters, and mostly in poor condition. Confined to the mountainous region of North-West India.
16. *Sphodrus indus* Chaud., Bull. Mosc. 1852, i, p. 67.
1 Ex. Found only in the mountains of North-West India.
17. *Pheropsophus caloirei* Dej., Spec. Gen. i. 1825, p. 301.
7 Ex. Common throughout India and in Ceylon, but much commoner in the north than in the south.
18. *Metabletus fuscomaculatus* Motch., Ins. Sib. 1844, p. 59.
1 Ex., but a second fragmentary specimen probably belongs to the same species. The numerous forms of this very variable species are widely spread over the southern palaearctic area, extending from Madeira on the west, through the Mediterranean region, to Central Asia and the Himalayas.
19. *Metabletus ephippiger* sp. n. (see p. 865).
20. *Cymindis glabrella* Bates, Proc. Zool. Soc. Lond. 1878, p. 719; id., Scientific results of the Second Yarkand Mission, Col. 1891, p. 20, t. 1. f. 17.
1 Ex., immature and crushed, but belonging apparently to this species, which has been known hitherto from Kashmir only.

Scarites limitaneus sp. n.

Length: 21-23 mm. Width: 5.75-6.5 mm.

Head with the lateral truncature straight, the preocular angle hardly projecting laterally, frontal impressions shallow, surface moderately striate in front, nearly smooth behind; mandibles rather small, finely striate, median carina strongly sinuate, left mandible with a wide basal tooth, right one with two teeth, eyes flat, genae shorter than eyes, projecting as far laterally; antennae reaching hind angles of prothorax, joints 5 to 10 hardly longer than wide; mentum rugose-striate, granulate at base, a median carina from apex of tooth to base, a lateral carina on each side near margins of lobes. Prothorax about a fifth wider than head and a fourth wider than long, base hardly produced, but with an obtuse angle at each end of the median part, its sides nearly straight, front angles each projecting forward as a small tooth, sides bisetose, curved near front angles, thence gently contracted, with a well marked tooth at each hind angle; median line fine, front transverse impression deep at sides, subinterrupted at middle, vaguely crenulate, basal foveae just indicated and lightly granulate. Elytra evidently dilated behind, their width increasing from 5.25 mm. at base to 6.25 mm. at apical third, where they are as wide as prothorax, four-fifths longer than wide, base granulate, emarginate at middle, its sides straight and rather strongly oblique, shoulders dentate; striae lightly crenulate, shallow at middle, much deeper at sides, especially near shoulders; intervals flat, convex behind shoulders, where 6 and 7 are narrow and subcostate, 3 with two pores near apex, granulation confined to interval 8 and marginal channel, that often present along the sides of the striae obsolete; surface smooth, apical half dull, covered by an isodiametric microsculpture. Underside impunctate; metepisterna twice as long as wide; protibiae with 2 to 3 denticulations above upper tooth; mesotibiae with two equal spurs.

Allied to *S. salinus* Dej., but smaller. Head similar, but with the antennal joints shorter; prothorax relatively wider, its sides less parallel, sides of base usually straighter; elytra evidently dilated behind (nearly parallel in *salinus*), the striae much less impressed, with hardly a trace of granulation along their sides, interval 8 not costate or coarsely granulate behind shoulder, the sides of the basal border more oblique.

Waziristan (without exact locality), 5 Ex.

Bembidion waziristanum sp. n.

Length: 5.5-6 mm.

Black: upper side rather faintly aeneous, palpi ferruginous, first joint of antennae, legs (except base of femora), and a vague apical spot on each elytron dull red.

Head with single deep parallel furrows, extending to sides of clypeus, neck wide, eyes rather flat, antennae rather thick, reaching basal third of elytra, surface vaguely rugose between the furrows, with a few fine scattered

punctures behind. *Prothorax* convex, cordate, about a fourth wider than head and as much wider than long, extremities equally contracted, sides rather strongly rounded in front, sinuate a little before base, the marginal channel widening a little on basal half, hind angles sharp and rectangular, with a well developed carina; median line and transverse impressions all moderately deep, basal foveae deep, surface smooth, basal area finely and irregularly punctate. *Elytra* moderately convex, oval, a half wider than prothorax, three-fifths longer than wide, border at base reaching stria 5; striae moderately deep and very clearly punctate, much shallower, though visible, at sides and apex, 3 to 6 only disappearing just before apex, 2 shallow but visible near apex, 8 deep, joining 9 at basal third, scutellary striole fairly long, apical stria moderately deep, joining 7, the pore in the stria; intervals somewhat convex on disk, otherwise flat, the two dorsal pores on the inner side of stria 3. Microsculpture of elytra formed by fine strongly transverse meshes, none on prothorax or head, except on labrum and neck, where there are isodiametric meshes. Underside impunctate; metasternal process bordered.

Allied to *semilotum* Net., a little smaller and aeneous instead of blue. Head with deeper furrows, surface smoother and less punctate, eyes flatter; prothorax wider, with wider lateral channels, surface less punctate; elytra less contracted towards base, striae a little deeper with rather larger, clearer punctures, microsculpture of elytra similar, but none visible even on sides or base of prothorax.

Razmak, 6 Ex.

Bembidion palaciosi sp. n.

Length: 4.75 mm.

Piceous: head and prothorax blue; palpi, antennae, and legs flavous, elytra each with two large ferruginous spots, nearly meeting at middle.

Head with single deep parallel wide furrows, extending to clypeus, sub-interrupted opposite clypeal suture, eyes prominent, antennae slender, surface with a few scattered punctures behind. *Prothorax* convex, cordate, only a little wider than head, a fourth wider than long, extremities equally contracted, sides strongly rounded in front, sinuate close to base, marginal channel very narrow, hind angles sharp and rectangular, with a short carina; median line and transverse impressions all moderately marked, basal foveae small but fairly deep, surface nearly smooth, basal area finely but clearly punctate. *Elytra* moderately convex, ovate, about two-thirds wider than prothorax, three-fifths longer than wide, widest behind middle, border at base reaching stria 5; striae moderately deep and very clearly punctate, much shallower at sides and behind, 2 quite distinct to apex, 7 almost invisible, 8 deep, joining 9 at a fourth from base, scutellary striole fairly long, apical stria rather short, joining 5, the pore in the stria; intervals somewhat convex on disk, flat elsewhere, the two dorsal pores on stria 3. The microsculpture of the elytra is formed by very fine wide meshes; the head and prothorax are without any on disk, but meshes are visible on sides and base of prothorax, and also on the neck. Underside impunctate; metasternal process bordered.

Closely allied to the Central Asian *abbreviatum*—*dilutipenne*—*persicum*—*marginipenne* group, but the elytra are more clearly and deeply punctate-striate than in any of them. The elytra have exactly the pattern of *pamirensis* Bates, but the head and prothorax are blue; head with deeper frontal foveae, and much more prominent eyes; prothorax a little wider, with more strongly rounded sides, the base punctate, but not rugose; elytra with rather deeper striae, also slightly larger and deeper punctures.

Razmak, 4 Ex.

Licinus corustes sp. n.

Length: 9.5–10 mm. Width: 4–4.2 mm.

Black, rather dull, especially the elytra, apex of palpi dull red.

Head short, flattened in front, the foveae rather shallow, substriate, labrum only slightly emarginate, but strongly asymmetrical, clypeus bisetose, deeply emarginate, exposing the basal support of the labrum, which is not membranous and which is separated from the labrum by a deep sulcus, a transverse ridge in front of the clypeal suture, to which the curved emargination of the clypeus is almost tangential, antennae thickly pubescent from and including

joint 4, joint 1 as long as 2+3, and a little thicker than the other joints, eyes rather flat, surface finely and not very closely punctate. *Prothorax* cordate, rather flat, a half wider than head, a fourth wider than long, extremities equally contracted, moderately emarginate, sides bisetose, bordered, slightly but rather widely explanate, rounded in front, straight behind, hind angles strongly rounded and slightly reflexed; median line fine, becoming deeper and widening out behind, but not reaching base, front transverse impression shallow, basal foveae moderately deep, disk and front margin finely and sparsely punctate, surface otherwise rather coarsely and closely punctate. *Elytra* oval, moderately convex, a distinct emargination on each side before apex, striae fairly deep, and closely punctate, a little shallower near apex, intervals moderately convex, rather sparsely and irregularly punctate, the punctures more evident on the odd than on the even ones, the marginal series larger, along the middle of interval 9, marginal channel closely punctate. Microsculpture isodiametric, very distinct on the elytra, hardly visible on the head or on the disk of prothorax. Sterna and sides of venter at base finely punctate, the metepisterna and sides of metasternum more strongly punctate. Metepisterna a half longer than wide; both pro- and meta-sternal processes bordered.

Smaller than *astrabadensis* Reitt., the head much smaller, the prothorax much more contracted behind, the elytral striae deeper, and the intervals more convex.

Razmak, 2 Ex. ♂ ♀, unfortunately not in very good condition.

Harpalus confinalis sp. n.

Length: 7.5-8 mm. Width: 3-3.2 mm.

Black, moderately shiny: palpi and joints 1 and 2 of antennae ferruginous, rest of antennae fuscous, tarsi piceous.

Head convex, smooth, clypeal suture very fine, frontal foveae small, eyes not prominent, antennae slender, reaching just beyond base of prothorax, tooth of mentum very short and obtuse. *Prothorax* convex, subquadrate, very nearly a half wider than head, and about as much wider than long, base bordered, much wider than apex, sides unisetose, finely bordered, well rounded in front, nearly straight behind, without trace of sinuation, hind angles right and slightly rounded, median line very fine, transverse impressions vague, basal foveae small, very lightly punctate, a few punctures extending to hind angles and lateral channels, basal and apical areas rather uneven, middle of base slightly longitudinally striate. *Elytra* convex, subovate, barely wider than prothorax, a little more than a half longer than wide, shoulders with a rudimentary tooth, apex moderately emarginate on each side striae impunctate, rather fine, though clearly impressed, intervals nearly flat, 3 with a pore at apical fourth, 9 with a series of small punctures in addition to the larger ones of the marginal series bordering stria 8. Microsculpture isodiametric, barely visible on head and disk of prothorax. Underside smooth, prosternal process glabrous, metepisterna a half longer than wide, base of venter finely punctate and setulose, last 3 segments smooth, apical segment ♂ with two marginal setae on each side, metafemora plurisetose.

About the same length as *H. anxius* Duft., but wider, prothorax more rounded in front, so that the front angles are less evident, a little contracted behind (parallel in *anxius*), elytra wider, similarly striate, the humeral tooth rudimentary.

Waziristan (without exact locality), 4 Ex. ♂♂.

Metabletus ephippiger sp. n.

Length: 2.7 mm.

Flavous: prothorax and neck red, head, a deep median band on the elytra, covering nearly a third of their surface, produced along suture to base in front, and for a short distance behind, apex of elytra, and apex of venter piceous.

Head without any distinct frontal foveae, surface very distinctly but not closely punctate, eyes rather flat, mentum with a short obtuse tooth, antennae submoniliform. *Prothorax* cordate, just wider than head, not quite a half wider than long, base produced at middle, its sides oblique and emarginate, apex slightly emarginate, front angles adjoining neck, sides bisetose, finely bordered, well rounded in front, sinuate a little before base, the hind angles sharply rectangular and a little reflexed; median line and hind transverse impression moderately deep, front transverse impression obsolete, basal foveae slight, surface, like that of head, sparsely punctate. *Elytra* flat, gradually dilated behind and widest

not far from apex, four-fifths wider than prothorax, about a third longer than wide, truncate behind, leaving the abdomen exposed; striae so lightly impressed as to be barely visible, though nevertheless containing microscopic punctures, intervals flat, 3 with a minute pore at a third from apex, adjoining stria 3, a large umbilicate pore on each side of scutellum; surface with a few almost invisible scattered punctures. Microsculpture of prothorax and elytra formed by very wide meshes, that of head isodiametric. The pectination of the claws is very slight.

A little larger than *M. myrmidon* Frm., the prothorax red, the pale area on the elytra more extensive, the head and prothorax conspicuously punctate, the elytra with less evident striae.

Waziristan (without exact locality). 1 Ex.

FISHING FOR 'BOMBAY DUCK' (*HARPODON NEHEREUS*).
DESTRUCTIVE NETTING METHODS.

BY

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(With 1 plate and 2 text figures.)

The object of this paper is to place on record a few observations regarding the trade in 'Bombay duck' or Bombils (*Harpodon nehereus*), the methods of their capture and the manner of their disposal for commercial purposes. This paper is meant to be only an outline of suggestions for the future development of this valuable fishery. It is not a survey of the entire industry round Bombay, but is confined to the data gathered at Colaba only, which, during the monsoon is the main fishing centre for this fish. The first thing that strikes the observer is the appalling waste of the fish and the reckless and primitive methods used in fishing for them.

The paper deals with special reference to these two features, for the present writer, who has personally accompanied the fishermen in their operations, feels that the introduction of more modern methods would enable the fishery to be put on a more organised basis. For this reason it would be best to begin by referring to the existing methods of obtaining the fish.

The peak period of the fishing season in Bombay (for 'Bombay duck') is from June to September, and at this time the inshore waters are the haunts of innumerable kinds of fishes, both large and small, and crustaceans.

The net employed to capture the fish is a device known as the bag net, which in the vernacular (Marathi) of the fishermen is called the *dol*. The bag, which is of heavy cotton netting, is conical in shape, the base, which is the open end, being rectangular. The length of the net from the rim of the base to the tapering closed end is about 150 feet with a circumference at the mouth varying from 180 to 230 feet. The mesh of the net is not uniform throughout. At the mouth, the net has large meshes, which are about four inches in diameter. As the net tapers, the meshes become smaller in size and, towards the end are so narrow that the escape of the tiniest fish is rendered almost impossible. A peculiar feature of the meshing is that with the inrush of the water the interstices get completely closed. The net then resembles a hermetically closed cone. The pressure at the tapering end is very great both as a result of the inrushing water and the catch which is driven into it. In order to withstand this dual pressure this portion of the net is double (consisting of one bag enclosed within the other). Four men are usually required to operate

the net, and when the sea is very stormy, the services of a fifth man are at times requisitioned.

METHOD OF SETTING NET.

The net is worked entirely by the tides. It is set in the water, but in such a position as to face the incoming current. As the tide starts to recede, the position of the net is reversed, the open end now facing the shore. The object in both cases is for the fish to be propelled into the net by the force of the current.

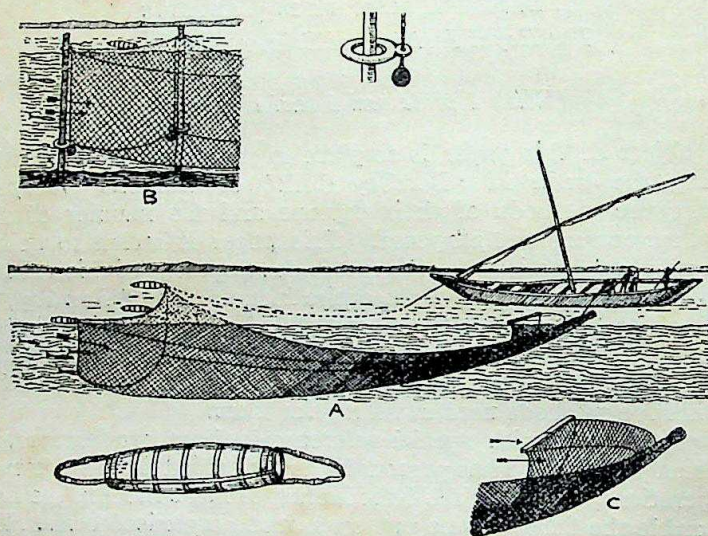
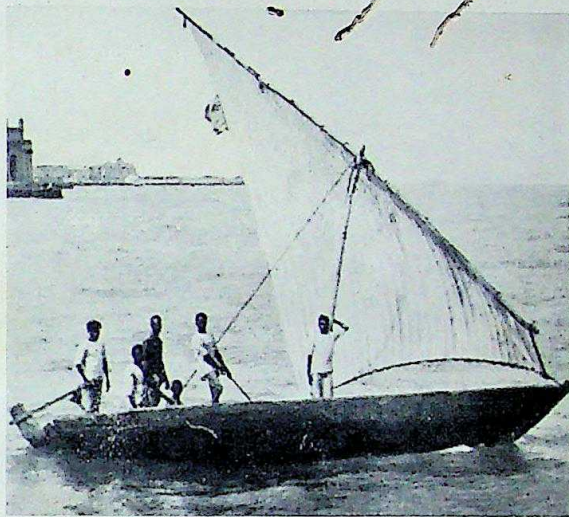


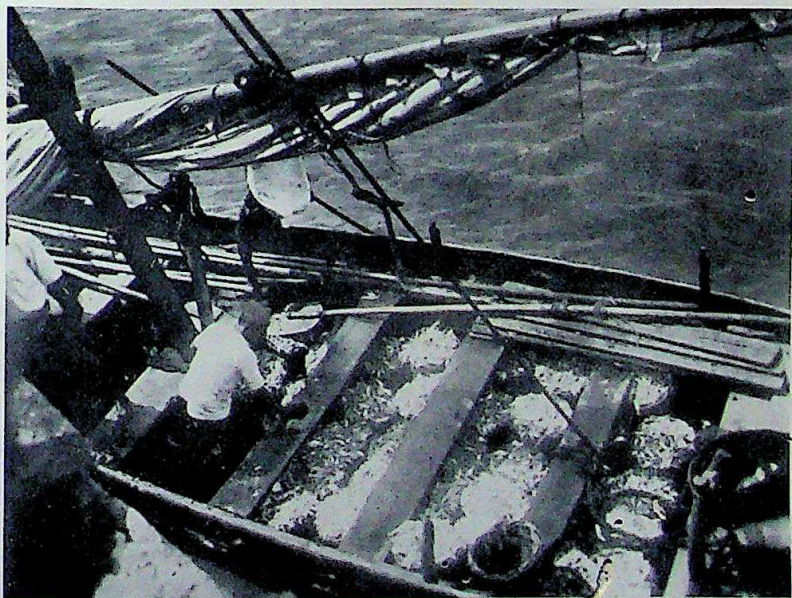
FIG. 1.

A complete "döl" outfit. The döl as used, (a) for inshore fishing; (b) for fishing in deeper waters; (c) the clever device known as "khuda" referred to in the text.

In setting the net, the top ends of the mouth are fastened to large buoys, which are permanently fixed by chains to huge rocks at the sea bottom. Besides this, the centre of the upper edge of the mouth is secured to a temporary float, which prevents the top of the net from sagging. The lower edge of the net hangs freely, the pressure of the rushing current keeping the mouth wide open. The fish are thus captured by being driven into the tapering or bag end, the opening there being closed with a rope knotted round it. The rope is long enough to enable the bag to rest on the sea floor. The fishermen are present on the grounds during the fishing operations and usually take a location in proximity to the bag end. In order to prevent the boats from being swept away from the scene of the fishing operations, a rope is tied from the bow of the boat to one of the fixed side buoys. This is the method followed in the case of the inshore fishing. In deeper waters a similar course is followed except that the place of the side buoys chained to the sea bottom is



A Bombay fisherman's sail boat as employed in the
Bombay Duck fishery.



A boat come back to shore with a part of the day's catch. During
the height of the fishing season many tons of fish were landed in
the course of a day.

FISHING FOR BOMBAY DUCK

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taken by two long and stout palisades, each about 100 feet in length and ten feet in diameter. These stakes are upright and formed by binding a few tree trunks till they are of the required length. They are then driven about twenty-five feet deep into the sea floor and the vertical sides of the net are attached to them. A buoy is secured to the upper edge of the mouth, as in the case of the inshore fishing, in order to prevent sagging. The time of fishing whether inshore or in deeper waters, varies from day to day, depending on the tides.

DEVICE TO PROTECT CATCH.

The description of the *dol* would be incomplete without reference to a clever device (known in Marathi as the *khuda*) of the fishermen to protect their catch from the depredations of sharks and other larger fish which feed on smaller ones. The ravages of these fish are not only confined to attacking the smaller fish, but also extend to ripping open the net and thus affording a means of escape to the catch. In order to safeguard themselves against this menace, the fishermen have devised a semi-oval net whose purpose is to prevent larger fish from entering the bag net. The upper side of the *khuda* is secured to a rod, which by floating keeps the mouth open. Its entire under surface is tied to the four corners of the dorsal surface of the bag end of the *dol*. The large fish are trapped in this and thus the fishermen derive a dual advantage inasmuch as these nets protect their catch as well as prevent the possibility of damage to their nets. Moreover the fish trapped are a good source of revenue as they also are sold for edible purposes.

The most serious drawback to this net is that it is non-selective in action. All kinds of fish are gathered irrespective of their size or commercial utility. The resultant wastage of this method is appalling, the nets often taking very many more fish than are required to supply the local demand for fresh fish. The method thus obviously entails the destruction of thousands of 'Bombay duck' daily which die long before they are rejected, for the fish are pressed to the bottom of the bag where they are lumped into a huge mass. They seldom recover and even if they do, they are thrown overboard together with the dead specimens.

RUTHLESS DESTRUCTION OF CATCH.

This ruthless destruction lasts not only during the season, when there is a demand for 'Bombay duck' but continues long after pomfrets, prawns and other better varieties are in season and the demand for 'Bombay duck' has long ceased. As the close of the monsoon approaches, there is a sharp falling off in the quantity of the catch of these fish and inshore fishing is gradually discontinued until in October no one fishes for them. Moreover, even during the peak period when there is a demand for them, none but the largest individuals are taken. The smaller ones, which are commercially useless, are cast overboard. Such a state of affairs would not be tolerated in any of the countries of Europe and

America, where the fishery laws lay down the different gear required in fishing for various fishes and prescribe the standard gauge of meshes for each of them.

In October the Bombay ducks decrease decidedly in abundance, the inshore fishing season ceases by the middle of October and the fishermen now venture further out into the deeper waters in pursuit of pomfrets and other bigger fish. The usual fishing grounds are near Khandaury about 25 miles away from Bombay. Here again, in addition to the drift nets used for pomfrets, the *dol* is employed, as it is more convenient and is a labour-saving device. It often happens that besides other fish, the *dol* takes in 'Bombay duck' but these are usually discarded as there is no demand. Moreover there is the risk of putrefaction as the fish is very delicate and the boats have to make a tedious journey of 25 miles. Sometimes the whole catch consisting of pomfrets, 'Bombay duck' and other fish have to be thrown away when the boats are becalmed, as they depend chiefly on wind and sail for their progress.

COLLECTION OF STATISTICS.

The statistics collected by the present writer during the current year give but an inadequate idea of the relatively meagre quantity to Bombay ducks that find their way into the market in proportion to the huge amount captured annually.

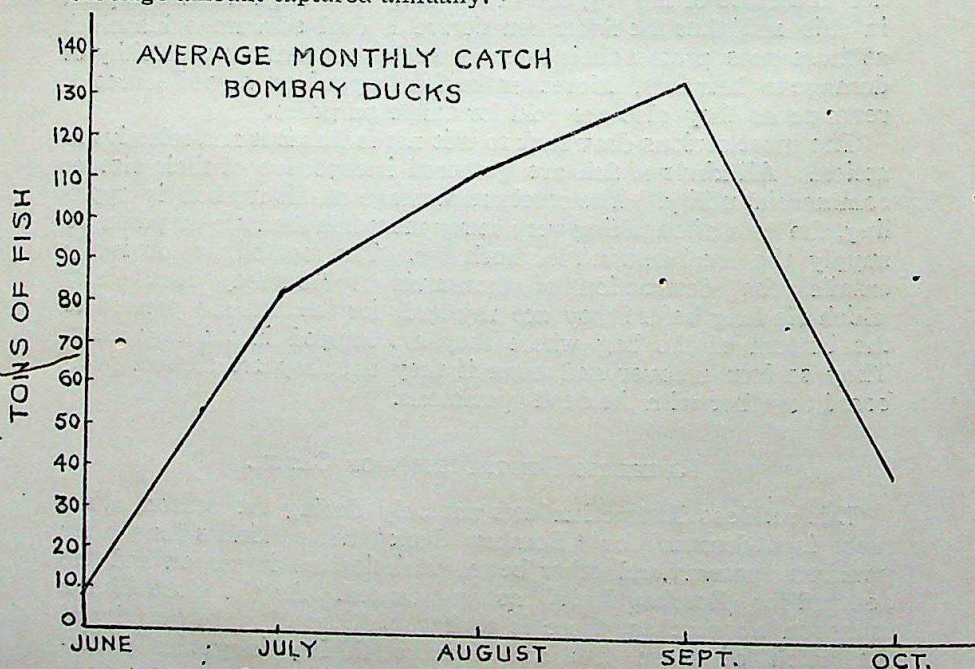


FIG. 2.

During the inshore fishing season at Bombay in 1931 (this year the fishing season began on June 16 and ended somewhat later than usual on about October 15), fifty boats owned by nineteen

individuals were engaged in fishing. The average catch per boat per day was 12 baskets (all of an identical size), each having a containing capacity of about 150 fish. The average catch per day of each boat during the period referred to above, was computed by adding up the daily catches of each boat made during that time. In calculating the average, only those days on which there were any catches, were taken into consideration. On some days the catch was very poor, on others the fishermen did not go out, either on account of repairs to nets or on account of holidays or the condition of the sea. Some boats brought bigger catches than the others, because they either used larger nets or employed more men. In order to collect the statistics, the writer visited once daily, and sometimes even twice, the landing site of the fish. In his absence, a man was deputed to be on the spot and ascertain the catch as soon as it was landed. The weight of the fish was calculated by determining with a spring balance the number of fish that went to a pound and dividing the entire number of fish by the number that made up a pound.

As soon as the fish were brought to the shore, they were sorted out, the larger ones, which had a marketable value were retained, while those, which were smaller in size or had been damaged in the net were discarded. The fish were auctioned on the wharf and fetched on an average eight annas per basket during June, July and August. The value declined in September and the diminution in price steadily continued with the approach of the end of the season when the supply considerably exceeded the demand. The fishermen then contrive to secure fewer Bombay ducks from the fishing grounds and this they do by opening the bag end and letting large quantities of fish (mainly Bombay ducks) run out into the sea. Despite this drastic measure to curtail severely the supply, the number of fish obtained was large and there were frequent occasions on which baskets were disposed off at the rate of an anna each. These prices, which the middlemen paid the fishermen, are thus very much cheaper than those charged to the consumers. The consumers hardly get the benefit of the low prices and owing to the indifferent sales methods and lack of organisation, large quantities of fish are not seldom destroyed. It is regrettable that such wasteful and wanton loss of fish should be tolerated. This scandalous waste could in a large measure be obviated by improving the method of catching fish with the *dol*, the use of which under the present conditions is an intolerable scandal and grave menace to the very existence of the fish as well as to the fishing industry.

NEED OF PROTECTIVE MEASURES.

Every civilised country has its own fishery laws and the facts set forth above indicate the urgent need of introducing some protective measures to safeguard our industry if not against depletion, at least against the wastefulness and destruction of fish consequent on the above methods. It is an unfortunate fact that no fishing laws are operative in Bombay waters, and there are no means of ascertaining with any degree of accuracy the actual quantity of fish wasted.

It would be needless to raise the question of depletion and it would not be scientific to take remedial steps before there are actual indications of depletion. There are also no records showing the annual catch of any fish. Without such information no definite statement can be made. The writer has no doubt that, notwithstanding this ruthless destruction, quantities of fish several times the amount referred to above, are available. The Bombay duck fishery is capable of furnishing several times the amount mentioned in case a demand should arise. The writer would therefore suggest that a small business could be built up at Colaba by utilising such fish and others unsuitable for the market for the manufacture of fish oil and fish manure. This observation far from denying the prevalence, along the coast, of the manufacture of fish manure, though the method followed in this respect is crude or of drying Bombay ducks for the off-season, is meant to call pointed attention to the need of placing our Bombay duck industry on a scientific basis. The fish manure would be of great benefit to the agriculturists. It is hardly necessary to emphasise once more the pressing importance of modifying the construction of the *dol* so as to give small-sized fish a chance of escaping, by making the mesh conform to a standard gauge. At the same time, intensive fishing with the *dol* over small areas—a method very destructive to the fish and detrimental to the interests of the fishermen—should be discontinued.

NOTES ON THE FAUNA OF BRITISH INDIA: BIRDS.

VOLS. IV, V AND VI. (*New edition*).

On page 468 *et seq.* of vol. xxxii of this Journal, Dr. C. B. Ticehurst has published some notes in *The Fauna of British India*, vols. iv, v and vi, and I have been asked by some of my friends to reply to this review. As a matter of fact it appears to me that very little reply is necessary. Dr. Ticehurst has written his notes in response to an 'urgent demand' by the Editors of the Journal and at the request of other friends. The first of these volumes was published early in 1927, vol. v, in March 1928 and vol. vi, in March, 1929, and Dr. Ticehurst's 'urgent' notes were published on the 15th of July, 1930.* As a matter of fact my own vol. vii, published some four months earlier than this, contains practically all the corrections shown to be necessary by Dr. Ticehurst, whilst the corrections to the latter half of vol. vi, and the corrigenda and addenda to the whole series were also in print at the time. Dr. Ticehurst very kindly forwarded to me his notes written for the Journal and I pointed out to him that with two exceptions the whole of these corrections were incorporated in vol. vii, which had already appeared or were in print in preparation for vol. viii. Dr. Ticehurst's review, therefore, seems to have been entirely unnecessary and for the most part is merely a repetition of the corrections which had already appeared in vol. vii of my own work.

It is true that I have not drawn attention to the misprints which occur unless these require to be pointed out because they might otherwise be misleading. Misprints which are obvious I have left to the intelligence of my readers. Misprints are bound to occur in any book or paper, however well written or edited—indeed even in the article in which Dr. Ticehurst calls me to account for my misprints, the same frequently occur.

Naturally, I much regret that it should have been necessary to publish in vol. viii so long a list of corrigenda and addenda, far more numerous and many of far more importance than any of those alluded to by Dr. Ticehurst, but it must be remembered that Ornithology is a science which is progressing and systematists and nomenclatorial experts are constantly finding facts in relation to classification as well as mistakes in nomenclature which have to be recognized and corrected. This is not a work of one man but of many and it is only by very slow degrees that we can advance towards the perfection at which we are all aiming.

In my preface to vol. iii, I have advised all the readers of *The Fauna of British India* carefully to correct the first six volumes with the help of the eighth and so accustom themselves to the nomenclature accepted in the latter as most up to date. I do not imagine for a moment that my nomenclature or my classification is final but it will at least serve as a basis by which writers can name their birds, more especially those writers who do not pretend to seek further into the mysteries of modern nomenclature.

E. C. STUART BAKER.

UPPER NORWOOD,
November 1, 1930.

*We are afraid that the Editors of the Journal are responsible for the late appearance of Dr. Ticehurst's review and Mr. Baker's reply. The review was sent to the Society on the 8th November 1929 and was published in July 1930; Vol. XXXIV, No. 2.

The delay in publication was due to the fact that Dr. Ticehurst's notes were received when Vol. XXXIV, No. 1, published in March 1930 was already in the press and publication was held up for the subsequent issue.—EDS.

EDITORIAL.

THE RETRENCHMENT OF THE SCIENTIFIC SERVICES IN INDIA.

For some months past, as the members of the Bombay Natural History Society are doubtless well aware, the Government of India has had under consideration the question of the retrenchment of the Government Scientific Services in India. The proposals of, and the orders passed by, the Government up to the present time are of such a drastic character that they have evoked strong protests from civilised countries all over the world, both from individual scientists of international reputation and from scientific and other learned societies; and we feel that the Bombay Natural History Society cannot allow these proposals to be put into effect without adding its protest to the chorus that has already reached the Government.

That the present financial situation renders some curtailment of expenditure on the part of Government necessary cannot be denied, but it is essential to the future development and well-being of India that such curtailment should be carried out only to such an extent as is absolutely necessary, with due consideration of the needs of the country, not only at the present time but also in the future, and in a manner that will interfere to the least possible extent with the responsibilities and the duties of these services. We cannot but feel that up to the present time these qualifications have not received adequate consideration at the hands of Government.

The extent and the method of application of the retrenchment to be imposed on the scientific services was referred to a small body of members of the Legislative Assembly, not one of whom, so far as we are aware, can claim to be considered a scientist or to have any first-hand knowledge of the various Surveys concerned and of the work that they have done in the past, are doing now or, what is still more important, what they could do for the development of the country in the future. One result, and a most unfortunate one, of the transfer of the Government of India from Calcutta to Delhi in 1912 has been to entail the isolation of the Government from any contact with those who have devoted their whole life and energy to the attainment of scientific knowledge and to the application of such knowledge to economic problems, for the headquarters of all the scientific Surveys, Topographical, Geological, Botanical and Zoological, are and have for many years been in Calcutta; and for some time past the Government has clearly betrayed a lack of knowledge of the work that the Surveys have done and a still greater lack of appreciation of their importance to India.

In other civilised countries a great deal of work of scientific importance, both theoretical and economic, is carried out by institutions and individuals other than those employed at Government's expense; but in India such a condition of affairs is not yet possible

to the extent demanded by the needs of the country. Scientific education in this country is still in its infancy and hence the need of Government support is all the greater; in this connection one cannot but contrast the present action taken by the Government of India with that taken by the Government of Great Britain. In spite of the urgent need of retrenchment in the latter country, a need that is as great, if not greater, on financial grounds as that with which the Government of India is faced, there has been no retrenchment whatsoever in the scientific personnel employed by the Government; schemes of future expansion have for the time being been dropped but there has been no actual going back. One cannot but feel that this is largely attributable to the fact that in Great Britain there is a large body of scientific opinion with which the Government is in close touch. Indeed, attached to the Government of Great Britain and working under the Privy Council there is a Board of Industrial and Scientific Research, part of whose functions it is to keep the Government informed regarding scientific matters and to whom the Government can turn for advice on any matter of scientific importance: moreover, this Board being attached to the Privy Council, is thereby removed from any question of political, as apart from financial, advisability or necessity.

In this country the Government of India in 1921 abolished the only scientific advisory body that it possessed, namely the Board of Scientific Advice, and thus deliberately deprived itself of the only source that it possessed of obtaining the advice of a body of scientific men in its employ on scientific matters.

Some two years ago the Bombay Natural History Society was consulted by the Government of Bombay regarding the desirability of establishing a National Research Council for India; other bodies throughout India, such as the Asiatic Society of Bengal and the Indian Science Congress, were also consulted on the same matter, and they unanimously urged the Government to create such a Council, one of the functions of which would have been to advise the Government on just such problems as they have now to face. Unfortunately, nothing has as yet been done in the matter; and in consequence one cannot but feel that the Government, deprived of the benefit of the advice of any body of educated scientific opinion, has by its present proposals definitely surrendered or is in grave danger of surrendering the scientific needs of India to politics.

The question of the retrenchment of three of the scientific Surveys of the Government, namely the Geological, Botanical and Zoological Surveys, cannot be separated from the further question of the adequate maintenance of the Indian Museum, Calcutta, since the scientific staffs of the Natural History and Economic sections of the Museum are provided entirely by these Surveys.

The proper maintenance of the Indian Museum is absolutely essential to the future of India; at present it is one of her greatest educational assets. Every research worker in India, in Geology, Botany, or Zoology, would without hesitation offer his testimony to the very great help that he has received from the Museum in his work—help without which it would have been impossible for him adequately to carry on. Furthermore, the priceless collections in the

Museum, both those displayed in the Public Galleries and those contained in the Research Collections, which are open to inspection and examination by every *bona fide* research student in the country, cannot be neglected. In 1875 the Government of India, at the request of the Asiatic Society of Bengal, created a national Museum for India and made itself responsible for the proper care and maintenance of these collections; and their responsibility is far greater now than it was then, owing to the increased size of the collections and to the vast amount of research work that has been carried out on them, the result of which work has been to raise India to the scientific status that she now holds among the civilised countries of the world. By the present wholesale reduction in the scientific staff of the various Surveys, the Government of India is deliberately ignoring the onus that devolves on it in this matter, and is repudiating its responsibility for the careful maintenance of these valuable collections that do not belong to it.

As the Indianisation of the Surveys continues (a process that is even now almost complete in the Zoological Survey, since the present Director is the only European Officer), and the economic development of India progresses, as it must progress if India is to retain her position as a civilised nation, the need of fully trained Indians will be paramount; yet by their drastic reduction of their scientific personnel the Government of India are deliberately depriving this country of the officers whose knowledge will in the near future be all-important.

For some years past the Zoological Survey of India has associated itself with all the zoological work that is being carried out in India and has extended assistance and encouragement to all who are interested in the subject, and especially to the zoological departments of the various universities. With a far-sighted appreciation of the needs of these teaching institutions, the zoological Survey has recognised that unless the professors and lecturers of these universities are themselves engaged in research-work, they must of necessity rapidly deteriorate into mere exponents of text-book statements, and that it is only by his own research and by encouraging research-work by his advanced students that a professor can stimulate the enthusiasm of his students and rouse in them the desire to help to contribute in their turn a little to the sum total of our knowledge. Many of our universities and colleges are indebted to the Zoological Survey for the presentation of named specimens to their small teaching museums or for the correct identification of animals submitted to them for examination. The splendid library of the Survey has with great generosity been placed at the service of all *bona fide* research workers, and it is no exaggeration to say that without this concession zoological research work in India would be so hampered that it would be impossible to attain or to maintain such a standard as is now-a-days necessary. With a reduction in the numbers of the gazetted staff of the Survey there must, of necessity, go a serious diminution in the amount of research work published by the Survey; and this must in turn tend to jeopardise the maintenance in an up-to-date condition of the library, since this depends to a very large extent on exchanges with scientific and learned societies and institutions all over the world. The Zoological Survey at the present

time exchanges publications with some 300 such bodies, and this number is steadily increasing. Only those who have had occasion to consult the library can appreciate the value of this system at its true worth; but the Government of India would very quickly realise its financial advantages if in the future it became necessary, owing to the withdrawal of their exchanges by these other institutions, to purchase their publications at the market price, instead of under the present arrangement merely having to strike off the necessary additional copies of the *Records* and *Memoirs of the Indian Museum*.

There are but few problems in Agriculture, Sanitation or Preventive Medicine that do not include some problem in Zoology, and the result to India of the contemplated retrenchments in the Zoological Survey, with the consequent deterioration of the library and the curtailment of the staff, will produce an effect in this country that may be realised if one tries to envisage what the destruction of the Natural History section of the British Museum would be to England.

That economies in the workings of the various Surveys can be effected we do not doubt. One way in which such economy could be brought about is by a greater degree of collaboration between the various departments: as an example we may cite the unnecessary delay and expense that was entailed only a year or so ago by the creation by the Agricultural Research Council of a special Locust Research Survey, when an Imperial Economic Entomologist, with a trained subordinate staff at Pusa, and a Zoological Survey of India in Calcutta were already in existence.

In conclusion, if it be not too late, we would urge the Government, before it takes any irrevocable action, to appoint a Committee of scientific men in this country to go into the whole matter and prepare a scheme of retrenchment, whereby adequate savings may be attained without involving such serious steps as the wholesale retrenchment of a scientific personnel which in the near future will be absolutely indispensable to India's progress, or the neglect of the very valuable scientific collections for whose care and preservation the Government of India made themselves responsible more than fifty years ago.

SALE OF THE ORNITHOLOGICAL COLLECTIONS AT TRING.

While the prevailing depression has had its adverse effect on Scientific work in India its effect is equally apparent in England. The famous Bird Collection at Tring is to go to America. Lord Rothschild has been compelled to sell it to an American Museum. Ornithologists throughout the Empire have learnt of his Lordship's decision with dismay. The passing of Tring is a loss not only to British Ornithology but to European Ornithology and to Ornithologists the world over. While the bird collections at Tring were in no way comparable to those at the British Museum, they formed a perfect complement to the collection in London. They contained just those specimens which the British Museum required to make its collection complete. Tring is within easy reach of London, and London is where Ornithologists must go if they are doing work of real importance. The collections in both institutions were hence readily accessible to

workers. The removal of the collection to a location so difficult and expensive to reach cannot but prove a serious obstacle and Ornithologists will now solely miss the facilities they so long enjoyed. Besides a considerable part of this collection is concerned with European Ornithology. Take for example the Brehm collection with its 371 types, and it is by workers in Palaearctic Birds that the loss will be most keenly felt. They will be cut off by so many thousands of miles from this one though highly important collection which is now to be housed across the Atlantic. And though the Americans have acquired the Tring Collection they will be still compelled to visit Europe to consult the European collections if they are to do work of any real value in European Ornithology.

It was always believed that this great collection would ultimately become the property of the Nation and many of those who contributed to it were very probably influenced by the consideration that they were helping to build up a National asset. It is undoubtedly also for this reason that the British Museum refrained from entering into competition with Lord Rothschild who is one of its Trustees. There was always the most friendly rivalry, and co-operation between the Government and the private museum.

The pity of it is that the whole transaction was shrouded in secrecy. It has been pointed out, for reasons which have not been made public, that neither His Majesty's Government nor the Trustees of the British Museum were approached in the matter. There is nothing to be said about Lord Rothschild's right to dispose of his private collections and one cannot but deplore the circumstances which compelled him to take this decision, but it is difficult to discover reasons why an offer was not first made to the Nation to acquire a collection upon which it had reasonable claims before deciding on its sale to a foreign country.

REV. FATHER E. BLATTER, S.J., Ph.D., F.L.S.

Rev. Father E. Blatter, S.J., Ph.D., Vice-President of the Society, was the recipient for the year 1931 of the 'Johannes Brühl Memorial Medal.' The announcement was made at the Annual Meeting of the Asiatic Society of Bengal held on Monday 1st February 1932. The award was made in recognition of his 'Conspicuously Important contributions to the knowledge of Asiatic Botany.'

Father Blatter requires no introduction to the readers of this Journal. For more than 25 years we have continued to publish many of his important contribution on Indian Botany and we hope that we shall be privileged to do so for many years to come.

The Committee of this Society on behalf of its members takes this welcome opportunity of congratulating Father Blatter on the honour that he received for his labours in a branch of study which he has so greatly adorned and of expressing their deep appreciation of the manifold service he has rendered this Society during his long connection with it.

OBITUARY.

MR. G. M. RYAN.

(From the *London Times* 12-1-1932).

Mr. George Michael Ryan, F.L.S., late of the Indian Forest Service, who died at his residence in Ladbroke-gardens on Friday, was widely known for the application of his scientific knowledge to the improvement and preservation of old, historic trees in these islands. He was in the Indian Forest Service from 1883 to 1914, mostly on conservancy work in the Bombay Presidency, and reached the grade of deputy conservator in 1892. His researches and practical work on the preservation of old trees won the support of the authorities of Kew, who referred to him inquirers from all parts of the country. Among the trees on which he advised was the famous old yew standing in Bookham churchyard, and the oak in Holmwood Park, Keston, under which Wilberforce sat with Pitt when he decided to bring in a Bill for the abolition of slavery in British plantations. It was described in his diary as "an old oak." Last year Mr. Ryan drew the attention of the Council for the Preservation of Rural England to the neglected condition of the Queen's Oak or Robin Hoods Oak in Sherwood Forest, and wrote that the presence of a caretaker was of little use so long as this 'historic monument' was not scientifically treated for the further preservation of its life. Mr. Ryan was a generous-hearted man with many friends.

[Mr. Ryan was an old member of this Society. During his residence in India, he contributed a number of notes to the Society's Journal mostly of Botanical interest. Among his contributions were the papers on Wild Yams as famine foods and the Water-yielding plants of the Thana Forests.—Eds.]

AN APPEAL.

(From the *London Times* 12-1-1932).

FRESHWATER EELS IN BRITISH INDIA.

For some 10 years now I have been collecting data regarding the occurrence or absence of freshwater eels—of the genus *Anguilla*—in the freshwaters of the world, and we seem on the whole to have cleared up this matter. Yet there are two regions where some uncertainty still reigns, and curiously enough, British India is one of them.

I have seen specimens of freshwater eels from the greater part of India, from Burma to Bombay, but whether they occur north of Bombay, and especially in the River Indus, I have not succeeded in determining, neither through the available literature nor through questions. Yet it would be astonishing, it seems to me, if there were no information on this subject from one of the principal river systems of the Old World.

The question is of considerable importance for the understanding of the distribution of the freshwater eels which spawn in the Indian Ocean. It would be of interest, therefore, if Indian zoologists or others concerned with the fisheries there could take notice of the question and *discover whether freshwater eels of the genus Anguilla are really present or wanting in the River Indus.*

I am, etc.,

JOHANNES SCHMIDT,
Carlsberg Laboratorium, Copenhagen,
Denmark.

REVIEWS.

THE FAUNA OF BRITISH INDIA, INCLUDING CEYLON AND BURMA. REPTILIA AND AMPHIBIA. By Malcolm A. Smith. (Vol. I. Loricata, Testudines. March, 1931: London). Published under the authority of the Secretary of State for India in Council and edited by Lieut.-Col. J. Stephenson, F.R.S.

The object of the 'Fauna of British India' series is, and should be, the advancement of knowledge concerning the animal population of the great Indian Empire. In the past the average zoologist had an eye mainly for the structural details of a long-dead specimen in a museum, but fortunately the trend of research is gradually changing and the young biologist is seeking more and more the knowledge of the living. At the request of the Editor, Dr. Smith has included in the volume under review a general account of the structural characters and habits of the group, so far as possible, and in so doing he has laid herpetologists and naturalists in general under a deep debt of gratitude. The volume in its present form is not only useful to systematists, but can be consulted by advanced students of Indian Universities, especially of the Agra University where Reptilia is taught as a special subject for the M. Sc. degree, as a text-book on the subject.

It is to be borne in mind, however, that 'In the exact distribution of species, in their individual variation, in habits, life-histories, in fact in bionomics generally, a vast amount of investigation is still to be done.' The work on the bionomics of a group of animals can generally only be accomplished by those in the field, and it is earnestly to be hoped that naturalists with a real love for the living animal will supply the deficiency as they have so admirably done in the past. Dr. Smith's work as he states, shows by its omissions how much still remains to be done in this direction.

Great pains have been taken to make the volume useful even to a beginner. A glossary of technical terms is included and a comprehensive bibliography is given. In the introduction the author explains the generally accepted rules of zoological nomenclature, and one is painfully reminded how by their strict application some of the very familiar names have to be suppressed, and practically unknown names substituted, before finality in nomenclature can be reached. The introduction also contains a history of Indian Herpetology with short biographical sketches of the prominent workers. The zoogeography of Indian Reptiles and Amphibians is treated in a fascinating manner; and suggestions are offered regarding the preservation of specimens. This introductory account is evidently meant, though nowhere so stated by the author, for all the four volumes which Dr. Smith intends to bring out in this series on Reptilia and Amphibia (Volume II will be devoted to the Lizards, Volume III to the Snakes, and Volume IV to the Amphibia).

Dr. Smith's work covers the Indian Empire and the Indo-Chinese Sub-region; the inclusion of the latter is justified by the author on zoogeographical grounds. By this arrangement the new volumes of the 'Fauna' will include a number of species not treated by Boulenger in his volume on the 'Reptilia and Batrachia.' Considering the fauna of the Indian Empire one finds that since 1890 only five new species have been added. This bears out Dr. Smith's remark that in this group of animals no great field remains for a mere collector in search of new species. In Boulenger's volume 44 species of Chelonians were described, whereas in the new volume there are only 43 from British India, in spite of the added species. This shrinkage in the number of species is due to an examination of large material, and a careful and detailed study of the types of species, whenever available. Of the 57 species treated in Dr. Smith's volume, 14 do not belong to British India.

It is a matter of considerable satisfaction that Dr. Smith's volume is comprehensive and complete in itself, whereas information in Boulenger's volume has to be amplified by reference to his Catalogues of the British Museum.

The work is beautifully illustrated, but unfortunately Dr. Smith has omitted to give the magnification of the figures in the text and in the plates, and, moreover, some of the figures are crooked in the text (fig. 38, for instance). It would have been better if in the description of figures the names of the authors of species had been repeated. A casual perusal of the volume has shown that some page references in the synonymies are inaccurate, but in a work of this magnitude such mistakes are apt to occur.

In reading this volume one feels that the author is writing from a first-hand knowledge of the mode of life of the animals he has so admirably classified for the 'Fauna.' Dr. Smith is to be congratulated on this production. Herpetologists and naturalists in general will look forward with keen interest to the remaining three volumes in the 'Fauna' series by the author of the work here reviewed.

S. L. H.

A TEXT BOOK OF ELEMENTARY ZOOLOGY by Mr. Bonavis Bonnel, M.A., xiii, 192 pp. illustrated. Second Edition, revised and enlarged, Published by Kesari Printing Works, Madras, 1930, and sold by the Christian Literature Society, Madras. Price Rs. 2.

The book, which is running its second edition, is primarily intended for the use of the students of the Intermediate classes of the Madras University, but will also be found useful not only by the Medical Students and the students of the other South Indian Universities, but also by those elsewhere in India. Since its appearance a few years back much useful information has been incorporated by the author in order to free it from its originally much more limited scope and application.

The first few chapters are devoted to general biological considerations. Then follow the life histories of some 14 types treated in detail. A commendable feature of these is that Indian types have been mostly described. This avoids divorce, at one time a very common defect of the biological teaching in India, between the types used for lecture purposes and those actually studied in the practical class. Even where the former were imported the student learnt little of their *biology*: he merely looked at the dead animal and dissected it. This incompatibility, inculcating as it did confusion of thought and ideas and slovenly habits, is happily now disappearing. The authors who like the present one are helping in this very necessary reorganisation are to be highly congratulated.

The study of the types is begun with the Frog, a most convenient type, with which to initiate a beginner into the study of Zoology. The author then takes up Protozoa (Amoeba and Paramoecium), and beginning the Metazoa with Hydra and Obelia, takes the reader through Coelenterates, Arthropoda, Mollusca, Pisces and Aves to Mammalia. In the selection of types and their arrangement although subjective considerations of the authors naturally play a large role, one asks whether after all, on the principle of 'from the known through the less known to the unknown' which is applicable with particular force to the teaching of beginners, it would not have been a better arrangement to relegate the progressively less known types (and certainly of the *microscopic* Protozoa) to later chapters.

The last chapter is devoted to 'Classification, Evolution and Heredity.' Although the treatment on the whole is less satisfactory both from the points of view of the material and presentation, Evolution and Heredity are much more satisfactorily treated than classification. The treatment of the latter is sure to leave a good deal of vagueness in the mind of the student and stands in need of much amplification and elucidation.

For the rest the language is simple and clear and the descriptions of the types methodical. The diagrams though ample in number, leave much to be desired in quality. Students, specially elementary students for whom the book is intended, require not only clear and methodical descriptions, but also well shaded, clear diagrams and realistic pictures.

There are a few printing mistakes in places.

N.K.T.

BOTANISCHE VERSUCHE OHNE APPARATE —By Dr. Hans Molisch emer. o.o. Professor und Direktor des pflanzenphysiologischen Institutes an der Universität Wien. xii + 200 with 62 figures. Gustav Fischer Jena, 1931.

The author of this highly engaging and instructive book is already a renowned botanist and the writer of several standard botanical treatises, both technical as well as popular. He is also a keen and widely-travelled naturalist, and, until recently, was the Professor and Director of the Plant-physiological Institute at the University in Vienna. This latest, though one hopes by no means the last, of his publications, therefore, comes to inherit all the rich and varied experience, gained through wide travelling, close observation and deep thought, on the various phenomena of plant-life. Besides these, the reader also has the benefit of his mature experience as a teacher and investigator.

The motto of the book is 'The simpler the experiment, the finer it is.' In keeping with this, most of the observations and experiments detailed in the book, and the methods employed for their elucidation, are so simple that one begins to wonder why these did not strike every one else. Indeed, in this connection the author says in the preface that he has often asked three questions of his students and colleagues:—(1) Whether it is possible to hear the footsteps of a housefly without the use of a microphone, an amplifier or other apparatus? (2) Whether it is possible to observe the Brownian movements with unaided eyes? (3) Whether one can see the sun-light or lamp-light through wood several centimeters thick? The answer to the perplexed audience, the author informs us, has always been 'No, it is not possible.' Yet the book demonstrates that not only these, but a large number of similar other apparently perplexing phenomena, *are possible*.

In regard to this prevalent lack of observation and information, the author notes, as others who have devoted thought to the question that it is the modern tendency, which suffers from too great a stress being laid on details and technique, at the sacrifice of the more general and obvious facts which are ignored, that is responsible for the undesirable state of affairs. The result is that most students of Natural Science move through woods and fields more or less blind-folded, as it were, and return from their excursions with much poorer knowledge and experience.

One of the objects in writing this book, presumably, is to counteract this growing tendency and to create a lively interest for natural phenomena in the minds of the youth. It brings together a rich harvest of facts culled carefully from all aspects of plant-life and so simply dealt with that they can be easily investigated even while moving about, since little equipment is needed beyond a needle, a blade of straw, a glass tube and a match-stick. In most cases even these can be largely dispensed with. In fact, after reading through the book one feels surprised with how little apparatus one can carry on botanical investigations. *It is indeed the claim of the author that this is the first book ever written, which demonstrates a large number of observations and experiments without the use of complex or even simple apparatus.*

In the book are dealt with all variety of subjects covering a large number of phenomena. It is divided into five sections:—(1) Anatomical and Morphological, (2) Physical, (3) Chemical, (4) Physiological and (5) Miscellaneous. Under these are treated a surprising mass of facts covering almost all aspects of plant-life, personally investigated by the author himself.

The book is written in simple German so that it is easily comprehensible by beginners and laymen. Although primarily meant for these, it would be without doubt of very great utility also to serious students of botany and to teachers, specially on excursions. Many of the experiments are new, or are not described in other text-books. Where necessary, the text is illustrated by clearly executed illustrations. Although the book has been written with particular reference to European conditions, the facts are so general and most of the plants so common, or substituted without much trouble, that it can be easily adapted to conditions in India and other countries. Besides, where difficulties arise, it will well repay the effort to tackle and solve them. In view of this it is unfortunate that such books are not yet available to readers whose knowledge is confined only to English, but one hopes that this pioneer work of the author will sooner or later be followed by similar works in that language too.

N. K. T.

MISCELLANEOUS NOTES.

I.—AGE OF ANIMALS.

In *P. Z. S.*, pt. I, 1931, there is a very interesting and illuminating article by Major S. S. Flower on "The Duration of Life in Vertebrate Animals." It, with its four predecessors, is the first complete account of the duration of life in vertebrate animals, based on actual observations over a number of years.

I very recently came across a similar attempt in an old Sanskrit work¹ whose author flourished in XIIIth century. The work purports to be a text-book of Zoology discussing various matters, both interesting and curious. The author has attempted to describe life histories of about fifty-four vertebrate animals. The method is not scientific, as we understand the term; yet the work is valuable, both as the first—and perhaps only—attempt of its kind in the whole field of Sanskrit literature and as a collection of beliefs about animals prevalent at that time. I will try—if the Editor of our Journal allows me—to discuss some of the items in the book in a future note. For the present, I confine myself to presenting the age-data as given, without attempting to criticise. I append a list of age-figures from Major Flower for comparison.

Animals	SPAN OF LIFE IN VERTEBRATES ACCORDING TO	
	Hamsadeva XIII Century	Flower in <i>P.Z.S.</i> 1931
MAMMALS		
Monkeys	10 years	10-15 years
Tigers	16 "	15 "
Lions	20 "	13 "
Cats	5 "	15 "
Hyænas	14 "	12 "
Dogs	10 "	10 "
Wolves	10 "	12 "
Jackals	10 "	15 "
Bears	14 "	16 "
Rats	1½ "	2-3 "
Hares	1½ "	5 "
Elephants	100 "	50 "
Horses	25 "	30 "
Asses	12 "	20 "
Rhinoceroses	22 "	25-30 "
Cows	20 "	25-30 "
Buffaloes	20 "	25-30 "
Goats	10 "	10 "
Deer	9 "	8-10 "
Camels	30 "	30 "
Boars	14 "	16 "

¹ *Mriga-Pakshi-Shastra*; by Hamsadeva, a Jain Author of XIIIth Century.
Trans. P. N. Press, Kalahasti. 1927.

Animals	SPAN OF LIFE IN VERTEBRATES ACCORDING TO	
	Hamsadeva XIII Century	Flower in <i>P.Z.S.</i> 1931
BIRDS		
Hornbills- (<i>Garuda</i>)...	10 years	25 years
Eagles ...	8 "	} 15 "
Hawks ...	10 "	
Swans ...	7 "	14 "
Peacocks ...	6 "	10 "
Ruddy Geese ...	6 "	14 "
		(various sp. Wild Geese.)
Cranes ...	4 "	18 years
Crows ...	5 "	6 "
Owls ...	5 "	6 "
Kausika Birds ...	5 "	— "
Parrots ...	5 "	17 "
Cuckoos ...	5 "	7-14 "
Pigeons ...	3 "	11 "
Blue Jays ...	3 "	— "
Sparrows ...	" "	— "
Cocks ...	2½ "	— "
Karetu Birds ...	" "	— "
Hérons ...	" "	19 "
Wagtails ...	" "	— "
Plava Birds ...	" "	— "
5 other Birds ...	" "	— "

AHMEDABAD,
December 30, 1931.

HARI NARAYAN G. ACHARYA,

B.A., F.Z.S.

[The periods relative to Birds are quoted by the Editors from Major S. S. Flower's series of papers on the Duration of Life in Vertebrate animals. IV Birds. (*P.Z.S.*, 1925. pp. 1365-1422), as the paper in question was not available to the author. The figures given for the birds are in the main relative to longevity estimated from data relative to birds kept in captivity in the Zoological Gardens at Giza, Egypt. Major Flower concludes from his study of data collected from various sources that as far as present evidence goes, no species of birds has a specific *longevity* of over 30 years but that many species have a *potential* longevity of over 30 years.

It is of interest to see from a comparison of the above tables that the duration of life of various animals particularly in regard to Mammals given by the 13th century writer accords fairly well with the conclusions arrived at centuries later. It would be very interesting to read further excerpts from the book to which Mr. Acharya refers.—EDS.]

II.—TIGER KILLING SWAMP DEER OR *GOND* (*RUCERVUS DUVAUCELLI*).

On the 10th March 1932, in company with Messrs. C. McCann and G. Nogueira of the Bombay Natural History Society

and others, we had the extraordinary luck to see a large tiger kill a *gond* or swamp deer just before noon in the Dhakka Chat Kadir on the Sarda River in the Philibhit District. We had gone out for the day to a spot called Pasian, due north of Allengunj Block, which is included in the Kishenpur Block of the South Kheri Forest Division. At Pasian, there is a high bank that overlooks the whole of the kadir. We arrived there just before 10 A.M., and had breakfast. After breakfast, we were sitting on the edge of the high bank watching *gond* feeding in a swamp some 300 yards north of us. About 800 yards N.W. of us was another swamp with a sandy strip on the west side of it. On this sand three *gond* were seated, two together and one further apart. While we were watching them a tiger sprang from the high grass and the solitary *gond* was seized, just as it entered the water, while the other two dashed off, yelling. One of the two, a young stag, joined the group near us. At the same time a number of Paddy-birds which were in the neighbourhood of the small swamp also rose and flew off. This took place at 11.15 A.M. The tiger held the *gond* down for some 15 minutes, partially in the water, and then picked up his kill as a cat does a mouse, and carried it towards the high grass. At 11.30 A.M., before entering the grass he put it down and then dragged it into the grass. We saw nothing more of him till 1.5 P.M., when he came out of the grass followed presumably by his mate, a fine tigress. They sat down on the sand, rolled about and then played together, like two huge kittens. It was a magnificent sight. They were obviously very pleased with life after a good meal. Ten minutes later, they retired into the grass to rest and did not reappear again till 3.55 P.M., when they again played about on the sand and sat about for 10 minutes, then disappeared into the grass for another meal, I expect. Only the tiger drank and that a little. This appears to agree with the observations of Best and Stewart that they don't always drink in the cold weather after a meal. We left the spot at 5 P.M. without seeing them again. All this we watched through prismatic field-glasses. The *gond* that were within 300 yards of us never left the water all day and stood most of the time gazing in the direction where their pal was killed. There were six stags and three hinds. It was impossible to stalk the tigers on foot owing to the enormous height of the *khagar* grass. We had no elephant.

HARIPUR, P. O.,

KHERI, U. P.

March 10, 1932.

L. D. W. HEARSEY,

Captain,

2nd Lancers.

III.—THE PERSIAN PANTHER (*P. PARDUS SAXICOLOR*) IN BALUCHISTAN.

I am indebted to the Bombay Natural History Society for the opportunity to examine the skin of a Persian panther obtained by Lt. A. H. K. Sangster at Sambaza in Baluchistan, 4,500 ft., during April 1931.

A description of this race of panther may be found in my paper in the *Journ., Bomb. Nat. Hist. Soc.*, vol. 34 pp. 77–80, 1930, a specimen

in winter coat from Pusht-i-Kuh in Southern Persia being illustrated in pl. VI. Sangster's skin, also in winter pelage, evidently resembles very closely the Persian skin in colour and length of hair, but the moult was not imminent and the hair shows no sign of matting into tufts. The ground colour is very pale buffy grey on the back and in the centres of the rosettes, but becomes paler on the flanks and passes into pure white below. The rosettes, are everywhere black, but their edges are somewhat ill-defined owing to the length and looseness of the coat, the hairs of which are about $1\frac{3}{4}$ ins. long on the back and tail, and upto $2\frac{1}{2}$ ins. on the belly. The flat skin measures: head and body 3 ft. 10 ins., tail 2 ft. 6 ins., the small size indicating a female or young male.

An interesting point connected with this skin is the discovery of this race of panther in Baluchistan, which brings it into the fauna of British India. Hitherto the most eastern locality known for it was Palan Kuh, Seistan, where Col. R. L. Kennion obtained a specimen as recorded in my paper referred to above. Col. Kennion's skin is a little darker, with the coat somewhat shorter and a good deal tufted.

I should like to take this opportunity of expressing to Lt. Sangster our great indebtedness to him for generously presenting this beautiful skin to the British Museum, as soon as he heard from me that there is no skin quite like it in the national collection and that it would be an appreciated acquisition. Sportsmen, very naturally, like to keep such trophies, as a rule, to be made up into rugs. Hence it is only rarely that the skin of freshly killed leopards, tigers, bears and whatnot, come into the Museum. Too often the national collection, which is in need of such animals, has to wait until they are dusty and faded, if not moth-eaten, from exposure. One of the attributes of Lt. Sangster's specimen is its absolute freshness.

NAT. HIST. MUSEUM,
S. KENSINGTON.

March 15, 1932.

R. I. POCKOCK.

IV.—USE OF ARTIFICIAL LIGHT IN PANTHER SHOOTING.

I recently read a note, by Col. R. W. Burton in the *Field* or *Game and Gun* I think, on shooting panther on foot with the aid of an electric torch.

Recently, while motoring down the Dhimbam Ghat (North Coimbatore) at night, the headlights of the car showed up a panther squatting on the roadside. The panther allowed the car to get within 30 yards of it before moving across and down the bank below the road, and I quietly brought the car to the spot where it had left the road. Leaving the engine gently ticking over, I unscrewed my spotlight (an 'Auto-reelite' with about 15 feet of wire attached), and quietly approaching the edge of the road, and directing the beam downwards, immediately spotted the panther sitting up only about 3 yards

off. The panther made no attempt to move while the light was on it, merely wrinkling its muzzle in a series of rapid noiseless snarls. After about a minute, I moved the light from side to side and the panther slowly made off. About 20 minutes later, when nearing the foot of the Ghat, the lights of the car showed up the eyes of what I at first took to be another panther, but on approaching close, found it to be a young tiger. Keeping the beam of the spotlight fixed on the tiger I brought the car slowly to the edge of the road abreast where the tiger was standing, quietly opened the door, unscrewed the spotlight and stepped out on the grass bordering the road. The tiger was complacently blinking in the glare of the spotlight and allowed me to approach to the limit of the spotlight wire, I was then about 15 yards from it, when it suddenly lowered its head quickly as if to get under the ray of light. I was almost as quick in lowering the beam, and raising it again as he threw his head up the next moment; but I decided however that discretion was the better part of valour: backing, I reached the car before I expected to and the slight noise caused the tiger to bound away with a "wough". I had no weapon with me at the time which I did not regret, as the experience with both the panther and the tiger was unique for me.

HONNAMETTI ESTATE,
ATTIKAN P. O. *via*
MYSORE, S. INDIA.
March 9, 1932.

R. C. MORRIS, F.Z.S.

V.—AN ALBINO CHITAL, (*AXIS AXIS*).

As it may be of interest to you I am enclosing two photographs of an albino Chital doe shot lately by an Indian gentleman in the Doon (?) it was brought to me as soon as shot in the flesh. It is snow white and only slightly coloured below the knees; the eyes and hoofs were pink; in a bright light faint spots of a silky whiteness can be seen. It has been mounted by us according to the measurements we were able to take.

DEHRA DUN.
November 20, 1931.

G. ATKINSON.

[The photos are unfortunately unsuitable for publication. Eds.].

VI.—VITALITY OF BISON MAULED BY A TIGER.

I enclose a photo of a rather remarkable bull bison shot recently here by Capt. G. Tedcastle Colquhoun, I.A.S.C. The bull, a very old solitary, was in many respects unlike any I have seen before.

One horn, as will be seen, was worn down to less than half its original length, the bison had lost half his teeth and the remainder were very worn down; the grey hair of the frontal ridge extended lower than usual; round and between the eyes the colouring was a dark golden brown; while other portions of the mask—the muzzle, the cheeks, and the under part of the jaw were thickly flecked with grey hair. The bull had a quite unusually developed dewlap, which on examination was found to contain a quantity of fluid. The bone of one hind leg had been bitten through by a tiger just above the hock and was dangling uselessly, the wound being foul; the other hind leg also carried wounds from a tiger's attack, as also, the animal's neck and face. The neck and shoulder on the off side bore scars and callouses from the tiger's mauling, and portions of the bull's face had been badly ripped and here the skin was hard, hairless, and like dried leather. The spread measures 36" (taken from the tip of the short horn), and it must have been quite 39" originally; the girth at the base of the horns is 21". The good horn carries 9 corrugations, while the short one bears marks of the tiger's claws and possibly teeth. From the condition of the animal's broken leg and other wounds we judged that it had been attacked two or three years previously and it is a mystery how it was able to survive the attack with a broken hind leg and terribly scarred as it had been, taking into consideration also its advanced age. The poor brute must have suffered a lot, which may possibly have accounted for the grey hairs. That it had not died from gangrene from its smashed leg is also extraordinary; on the inner side of the leg was a jagged hole through which could be seen a portion of the broken bone and this had obviously prevented the wound from healing up. The animal was very emaciated; altogether its end was merciful.

HONNAMETTI ESTATE,
ATTIKAN, P.O.,
Via MYSORE,
S. INDIA.
March 19, 1932.

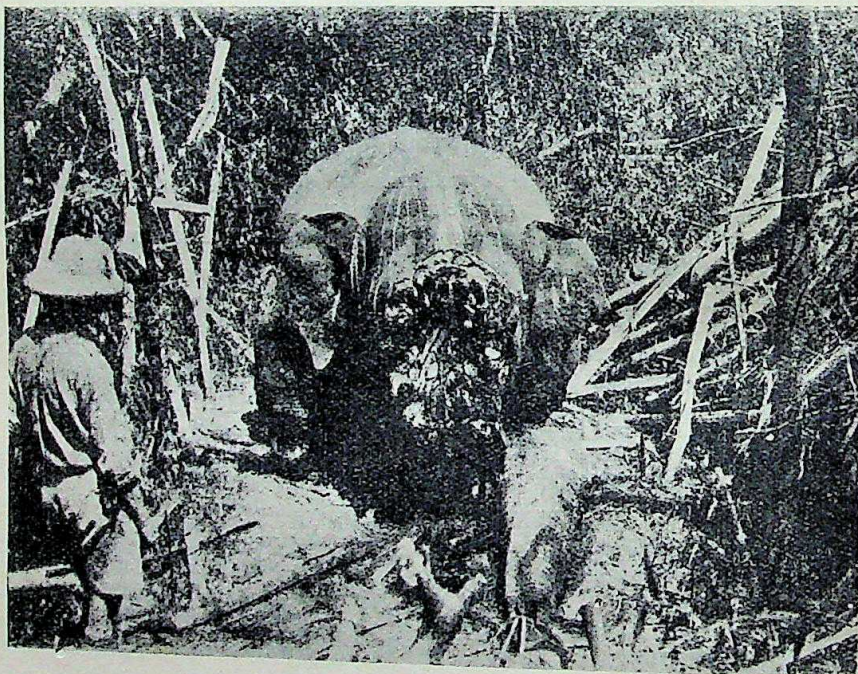
R. C. MORRIS, F.Z.S.

[The photo is insufficiently clear for reproduction.—EDS.]

VII.—UNERUPTED TUSKS OF ELEPHANTS.

I write with reference to Sir Frank Colyer's excellent article on Abnormal Tusks of Elephants in the Society's *Journal* of 15th November 1930. Sir Frank Colyer, who was good enough to show me his collection of abnormal tusks in the Museum of the Royal College of Surgeons in August last year, must be regarded as

an authority on the subject, but with all due deference to his opinion *re* the unerupted tusks found on the tuskless side of elephants with single tusks, I still hold that there is just a possibility that his views on the matter may not be quite correct. In his opinion, these unerupted ivories are caused and developed by a natural process of reformation on the original tusk having been torn out. This may possibly be so, but I still hold to my theory to the effect that the unerupted tusk is merely a malformed tusk, a freak of nature in fact, this abnormality being still more pronounced in 'Mucknas' which have no tusks. If 'Mucknas' were found to possess similar unerupted ivories, this would rather tend to prove my theory to be correct. After all, as 'Mucknas' exist, why should not there be single tuskers?



I enclose a photo of an elephant *minus* its face, rather a gruesome spectacle but interesting in the fact that the bony sheath on which this elephant's single tusk rested can clearly be seen, whereas there is no sign of it on the other side. If Sir Frank Colyer's contention is correct, there should surely be a similar bony sheath on the tuskless side. Sir Frank wrote to me on 26th February 1931 as follows:— 'Let me see if I can make the matter clear. A growing tooth in the jaw is always surrounded by a layer of dense bone. When the tooth erupts there is still a dense layer of bone around the root. If the hard part of the tusk is torn out and the wound does not go septic then the socket fills at first with blood clot, this is replaced in time by bone, the layer of hard bone disappearing except the portion covering the soft pulp. The soft pulp is in time formed into ivory with a layer of bone around. If the tusk is split so that a portion remains in the socket, suppuration

follows and the socket does not fill up and the layer of hard bone remains.'

HONNAMETTI ESTATE,
ATTIKAN P.O.,
Via MYSORE,
S. INDIA.
February 18, 1932.

R. C. MORRIS, F.Z.S.

VIII.—GAME PRESERVES AND FLASHLIGHT PHOTOGRAPHY.

I have recently been in camp with a big game photographer in an area which may later be turned into a game preserve. I cannot imagine anything more disturbing to game in a jungle than the flash and explosion of flashlights, and when a dozen cameras are placed abroad in the jungle at drinking pools, salt licks etc., the area is pretty well cleared of game in a few days. The flashlight powder is enclosed in a thin rubber bag, so forming a cartridge and intensifying the explosion.

HONNAMETTI ESTATE,
ATTIKAN P.O.,
Via MYSORE,
S. INDIA.
January 27, 1932.

R. C. MORRIS, F.Z.S.

IX.—SOME ANDAMAN BIRDS.

According to the *Fauna of British India, Birds*, second edition vol. II, I note that nothing is on record regarding the nidification of either the Andaman Shama or Osmaston's Bush Warbler. So I write to supply the deficiency.

(1) The Andaman Shama. *Kittacincla macroura albiventris*.

This bird is common in all the densely forested portions of the larger and smaller islands of this group. They specially frequent ravines near water. They have some fine loud, clear notes, as well as some harsh ones. They are very noisy in March and April, and almost at any time of the year they will answer any one who whistles a few clear notes within ear shot. Suspecting that the birds occupied clefts or holes in trees for nesting purposes, I had a number of boxes made—8" cubes—with a hole 3" in diameter on one side, and fixed them against the trunks of trees about 4 or 5 feet from the ground in dense forest wherever I heard a male Shama calling. This was done early in March.

I visited the boxes periodically after this, but none were occupied until May 21st when two contained nests ready for eggs. In the

next month, i.e. up to June 15, 9 of the 12 boxes I had put up had nests with eggs, mostly 3, but one 4 and two with 2 eggs only.

The nests filled the bottom of the boxes. They were invariably made of dry bamboo leaves, lined with black hair-like rhizomorph.

The eggs resemble those of the Indian Shama in colour. 12 eggs gave the following measurements :—

Maximum	...	0.89" × 0.68"
Minimum	...	0.80" × 0.65"
Average	...	0.85" × 0.66"

Subsequently, 3 nests of similar structure were found, one in a cleft in a buttressed tree, 9' from the ground and two others in holes in old rotten stumps, 5' up. I reared several of the young birds from the nest and kept them loose in my garden on Chatham Island. They were perfectly tame and fearless and fed from my hand. They were very fond of small centipedes. The cocks were exceedingly pugnacious. I utilized this trait in order to catch them when required. It was only necessary to show them a small mirror when they would instantly fling themselves against the glass and could be easily caught in the hand.

They copied tunes whistled to them with great accuracy. One was specially clever at reproducing 'Way down upon the Swanee River.'

(2) Osmaston's Bush Warbler. *Horornis pallidipes osmastoni*.

These birds are common in dense undergrowth of high or secondary forest and are never met with in the open. They are adept skulkers and though often heard, are rarely seen.

On May 19, 1907, while pushing through dense jungle near the top of Mt. Harriet (1000'), I came on a *Horornis* calling. I began to search for a possible nest, when the parent bird began to give its alarm call *chick-chick*. This spurred me on to further endeavours and shortly I was rewarded by discovering the nest within a foot of the ground. It was a deep cup-shaped structure—not domed, but completely sheltered by the leaf of a ginger. The nest was supported among the stems and leafstalks of the ginger-like plant and was very difficult to locate, as nearly every ginger plant had a similar accumulation of dead leaves near the base, which resembled a nest.

While examining the nest the parent bird came within 2 feet of me, although, as a rule, it is almost impossible to get a sight of one in the jungle.

The nest was composed of dry bamboo leaves very loosely put together and was lined with fine flowering grass-heads.

The eggs, four in number, were quite fresh. They are moderately broad ovals, very glossy and of a bright chestnut colour. Mottled all over, specially at the large end with a deeper shade of chestnut.

A second nest was brought to me on 10th July, containing 4 fresh eggs of a similar colour. The second nest was lined with black rhizomorph instead of grass :—

Eight eggs gave the following measurements.

1st. nest.	{	Maximum	...	0.70" × 0.55"
		Minimum	...	0.67" × 0.53"
		Average	...	0.68" × 0.54"

2nd. nest.	{	Maximum	... 0.69" × 0.54"
		Minimum	... 0.64" × 0.53"
		Average	... 0.66" × 0.53"

The call of the bird is most characteristic and peculiar, of 3 or 4 notes only, loud for the size of the bird, and insistent.

116, BANBURY ROAD,
OXFORD, ENGLAND.
January 10, 1932.

B. B. OSMASTON, C.I.E.

X.—NOTES ON THE BIRDS OF BALUCHISTAN.

27-8-31 to 1-9-31.—**Nutcracker.** (*Nucifraga* sp.) Takler Suleiman and Kaiser Garh range near Fort Sandeman, very common indeed in pine forest though not previously recorded in Baluchistan. Apparently the Kashmir variety, as its body is markedly more white-spotted than that of the bird with which I am very familiar in the Alps and have met on the Thibet border.

Crows. (*Corvus* sp.)—Same time and place; black crows were also common and apparently not previously recorded in Baluchistan.

Turtle Doves. Same time and place.—Several. I am uncertain which. Back vinous-red heavily marked with black. No white collar on neck that I could detect: tips of tail feathers apparently pale grey and not white.

6-7-31.—**Pheasant-tailed Jacana.** (*Hydrophasianus chirurgus*)—Khushdil Khan reservoir; only one previously recorded in Quetta district.

24-11-29.—**Red-breasted Merganser.** (*Mergus serrator*)—Khushdil Khan reservoir. Female (shot and identified)—only once previously recorded in Quetta district.

2-5-31.—**Indian Spotted Owlet.** (*Athene brama*)—on 'maidan' below Murdar.

4-12-29.—**Jackdaws.** (*Corvus monedula*)—some in a flock of rooks. Definitely no white collar. (I am familiar with 'collaris' in Turkey.)

Choughs. Here the *Birds of Baluchistan* appears to be astray. The 'bird of the highest hills' is invariably the Yellow-billed or Alpine Chough, a bird with which I am very familiar in the Alps and in Thibet. It is exceedingly common in both winter and summer at high altitudes and I have watched hundreds of them when stalking Markhor in the spring on Khangat, Takatu, Langlum and all the high mountains of Baluchistan. The Red-billed Chough on the other hand (as in Thibet) is the bird of the high plateaux. I have only seen it once or twice in the summer (August) and then no higher than 8,000 feet. It is a regular winter visitor to the Quetta plains and valleys.

16-2-29. 10-11-29.—**Meadow Bunting** (*Emberiza cia*)—Quetta—never seen again in 3 years.

18-8-29.—**Indian Red Munia** (*Amandava amandava*)—Quetta—a small flock.

15 and 30-12-29.—**Asiatic Goldfinch.** *Carduelis caniceps*

3-4-30.—**Spanish Sparrow.** (*Passer hispaniolensis*). Quetta. The only one seen in 3 years though I was always on the look-out for it.

17-2-30. **Blackbird.** (*Turdus merula*). Quetta. The only one seen in 3 years. I think the birds recorded near Liarat must have been the Himalayan Whistling Thrush.

House Martin. (*Delichon urbica*) Definitely a common bird on all the high mountains round Quetta all through the spring and summer. I saw numbers of them when stalking and climbing on all the mountains throughout my three years in Baluchistan.

21-8-29. **Flamingos.** (*Phaenicopterus ruber*)—Khushdil Khan reservoir.

5-4-29.—**Pelicans.** (*Pelicanus sp.*)—Khushdil Khan reservoir—big flock—saw them on several other occasions.

12-2-30, 6-3-30, 19-4-31.—**Black-headed Gull.** (*Larus ridibundus*) Khushdil Khan reservoir and Quetta Valley—About 10 % were in breeding plumage (*cf.* Meinertzhagen).

15-10-30 and 16-10-31.—**Cream-coloured Courser.** (*Cursorius cursor*) two or three on each occasion near Sayid Hamid on Quetta-Chaman road.

QUETTA.

E. F. NORTON,

January 4, 1932.

Col.

[The author in submitting the above notes indicated that they were extracts from his field notes, accumulated during his stay in Quetta in 1929, 1930 and 1931. His purpose in writing them was to put down any points which differ from, or confirm doubtful points in, the paper on the Birds of Baluchistan by Dr. Ticehurst. (*Journal B.N.H.S.* vol. XXXI and XXXII.)—Eds.]

XI.—BULBULS IN CALCUTTA AND ITS SUBURBS.

Recently, public attention has been drawn in the columns of certain influential journals to the regrettable fact that some of our well-known and familiar birds are growing less and less abundant; and that some species and varieties are actually threatened with extinction in spite of the existence of protective measures. In this connection we would like to mention a class of universally-liked birds, viz. the Bulbuls. Poets have sung rapturously of the bulbuls in the past and bulbuls have not as yet lost their position as pets among the rich and poor alike. It must not be forgotten that fifty years ago a bulbul-fight was as popular a sport as a horse-race, and as enthusiastically joined in by all ranks of men from the highest to the lowest. But apart from other interests, historical or scientific, bulbuls are very agreeable birds and the decrease in their numbers cannot but detract from the charms of the country life. There are several species of bulbuls in this country and their range of distribution is very wide. We are however concerned here with those species only that are found in or about Calcutta.

The Bengal Bulbul, *Molpastes bengalensis* is known popularly as the *kala* or black bulbul. In size it approaches the English Red-backed Shrike. Although its colouring is sombre, it is considerably relieved by the delicate grey and white of the edges of many of its feathers. In suburban gardens and village shrubberies, the notes of the Bengal Bulbul imitating the sound 'hickory, dickory, dock' may be heard only in the season. They utter another cry, composed

of incessant chattering, when they scent danger. Much as the black bulbul is liked for its cheerful and nonchalant ways and kept as a pet, it may be a very pugnacious bird at a moment's notice. In fact it is this fighting propensity for which the bird is prized by the lovers of the bulbul contests. The fighting bulbuls are carried about on small crutched sticks or special perches made of valuable materials, when the owner of the bird happens to be a rich man. Bulbuls are essentially lovers of quiet places, but the insatiable curiosity of the Bengal Bulbul sometimes induces it to visit towns and it is thus that pairs of these birds are seen on the road-side trees of Calcutta. The sight is however rare now. The diet of bulbuls consists mainly of buds and fruits, especially the bright scarlet fruit of the 'Telakucha' (*Cephalandra indica*) which is common in the hedges of the country-side. They are however not strict vegetarians, many bulbuls being seen to frequent the edges of ponds and watercourses in search of small insects and eggs of dragonflies. Bulbuls become very active at the end of the winter season and their nest-building operations extend from the latter half of February to the early part of June. The black bulbuls are not very particular about the choice of sites of their nests, these being found close to the ground on small shrubs as well as on the top of large trees. Nor do they care much to build in secluded places. The *Casuarina* needles, whenever available, form the most preferable building material. The nests are loosely made and display no special workmanship, except that they are reinforced with spiders' webs. The young birds newly hatched out, characterised by their rusty tinted plumage, are seen to accompany their parents for a few days. These young creatures are easily alarmed by dead leaves, twigs etc. and require some time to be accustomed to their surroundings.

The next member of the Bulbul family, in order of abundance, is the *Sipahi* or military or Red-whiskered Bulbul, known scientifically as *Otocompsa emeria*. It is a bird of more refined nature, both in appearance and habits than its black relative. Although a bit smaller in size than the Bengal Bulbul, the Red-whiskered Bulbul, so called because of the bright scarlet tufts on the sides of its head, is much the nicer-looking bird of the two, on account of its rich, brown wings, clear white under-parts and the shining, black, peaked crown. Their cheery and jubilant cries of "Did you, Did you, Do it" enliven the garden. It is a remarkable fact that while *Sipahi* bulbuls are common in the localities to the south-east of the Hoogly, they are not very numerous, and even rare in some spots, on the opposite bank. Tame and confiding by nature, *Otocompsas* love the neighbourhood of Man, coming into verandahs and porticoes and making friends with caged birds, especially of their own kind. They go about in pairs accompanied by their young, but never venture far from their nests. Unlike the black bulbul, the red-whiskered one will bestow much thought on the site of its nest, generally preferring sites hidden away among dense masses of foliage. The nests are never placed too high whether they are built on shrubs, climbers on walls or large, potted plants. The birds generally take a devious way in entering or leaving their nests, obviously with the intention of perplexing a preying enemy. The nests of the *Sipahi* bulbul are a little tidier

than those of the Bengal Bulbuls. In conformity with the gay appearance of the birds, the small eggs laid by them are also attractive-looking with their pinkish ground colouring decorated by red and purple spots. Usually there are three such eggs laid at the interval of a day, of which one is often abortive. The period of incubation is about 13 days and the young birds come out in the open in a week after being hatched.

Though not included in the Bulbul family (*Pycnonotidæ*), I would like to mention the Gold-fronted Chloropsis (*C. aurifrons*). Jerdon calls it the Green Bulbul; it is popularly known as the *haryah* Bulbul. It is not quite so common as the two former species, but this may be partly accounted for by the fact that their protective colouring effectively hides them from casual view. They fetch a comparatively high price as pet birds, and their ways are alluring although they tend to become greedy in captivity. But if they are greedy, they are certainly refined gourmands, as is evidenced by the manner of their eating. While a black or red-whiskered bulbul will break off small pieces from a ripe plantain and swallow them at once, the green bulbul will detach a large mass and keep it in its mouth, softening it by working the mandibles and gradually sucking down the juice. Green bulbuls have often been observed to congregate on kadamba trees (*Anthocephalus cadamba*) at the time of the ripening of the flower-buds. Apparently the balls of flowers are considered to be dainty dishes.

It is a matter of pity that the parks and gardens of Calcutta and its suburbs are not only now poor in bulbuls, but they are growing poorer too in bird-population generally, which, it must be conceded, is not desirable from at least the æsthetic, if not an economic, point of view.

CALCUTTA.

January 30, 1932.

N. B. DUTT.

XII.—MIGRATION OF PARADISE FLY-CATCHER— (*TCHITREA PARADISI*).

In a note on the migration of the Paradise Fly-catcher, (Journ., B. N. H. S., Vol. XXXV. p. 675.) I see that the Rev. F. S. Briggs doubts the accuracy of E. H. N. Gill's statement in regard to the United Provinces, that 'During the winter months this attractive bird occurs in most districts'. If Gill includes Bareilly District in his statement, I too have reason to disagree with him. I have now been in Bareilly since the end of September 1930. I spend a considerable amount of my spare time wandering about the district but so far I have never seen a Paradise Fly-catcher here during the winter. My first record is that of an adult male seen on April 8th. I was away in May and June, but on my return in early July, I saw these birds, usually in mango topes, not infrequently in that month and August. The hot weather is again upon us, but so far none have yet appeared. In other words, in Bareilly District, the Paradise Fly-catcher appears to be with us

only in the summer, arriving about April and leaving in September.

I came to Bareilly from St. Thomas' Mount, just outside Madras. In that place, I find I have no summer records at all, but many references to occurrences in the winter months, the earliest being October 7th.

I have also a few records with regard to the hills of Southern India. These are as follows:—

Mercara (Coorg).—One record only, 17th April 1924. I was in Coorg from 11th April to 16th May. F. N. Bates, however, in *Notes on the Birds of Coorg* says, 'Resident but not common.'

Kotagiri (Nilgiri Hills), which I have visited in the months of April, May, June, and July. One record only, 7th April 1925. 'A very pale-looking immature male.'

At Sigur at the foot of the Sigur ghat in the Nilgiri Hills, where I went for a week's shooting, I recorded one on 3rd January 1922. I was in the Palni Hills all April and May 1929, and saw no Paradise Fly-catcher.

As regards other parts of India, I notice I never saw the Paradise Fly-catcher at Pachmarhi in spite of being there from April 10th to well on into August, but B. B. Osmaston includes it in his list of Pachmarhi birds, remarking 'Rarely seen on the plateau. Common in the more open low valleys where they breed.'

If it is true, as appears likely, that one race at any rate winters in Southern India, and summers in Northern India, where is the dividing line?

In South Waziristan, by the way, I see that at Chagmalai, three miles from Jandola, I recorded the following: 15th February 1921, a female; 3rd May 1921, a young male; 12th May 1921, two adult males and a young male. These birds were evidently moving up into the hills.

19, CANTONMENT,
BAREILLY.
March 24, 1932.

R. S. P. BATES,
Captain.

XIII.—NESTLING OF THE INDIAN PIED KINGFISHER (*CERYLE RUDIS*) ATTACKED BY LARVÆ OF PARASITIC FLY.

On the 26th December 1931, I dug up a nest of this Pied Kingfisher which was in the east bank of the Benas River at Abu Road. The nest was about four feet deep. The entrance was a long narrow tunnel about 4" in diameter terminated by the nest chamber. The roof of the chamber was about 10" high at its highest point and dome-shaped. The floor was almost flat and on a level with the entrance. The base of the chamber measured about a foot across. In the nest were four fully fledged young, almost ready to leave the nest. The chamber was extraordinarily clean and showed no signs of excreta or remnants of food. However, the walls of the entrance tunnel were besmeared on either side with white marks of excreta, showing clearly that the parent birds were in the habit of cleaning

the nest. When the nest chamber was reached, the young hissed very softly from time to time,—much after the fashion of a snake—this was occasionally also the case when the birds were handled during captivity. After the first day of sulking, as is so common with freshly captured birds, they ate quite freely.

A curious point arose when I first extracted these birds from their nest. One of them was attacked by the larva of a Dipterous fly, which had lodged itself in one of the nostrils. Unfortunately, when extracting it I dropped it and lost it in the loose earth. I searched the chamber to see if there were any on the floor, without success. The fly had in all probability deposited its eggs on the bird itself. This bird was marked and observed. It did not appear to me as active as the others. A couple of days later it died. On examination I could find no external cause of death. It appears to me quite possible that this bird died due to the fact that it was parasitised by the fly. However, this is an open question. I have known several cases in which the young of birds have been parasitised by flies, but up to the present I have only observed this in nests on trees and bushes which are easily accessible.

BOMBAY NATURAL HISTORY SOCIETY,
6, APOLLO STREET, BOMBAY.
January 12, 1932.

C. McCANN, F.L.S.,
Assistant Curator.

XIV.—OCCURRENCE OF THE NUKTA OR COMB DUCK (*SARKIDIORNIS MELANOTUS*) IN THE LARKANA DISTRICT, SIND.

A Nukta was shot at Drigh Dand, in the Kambar Taluka, Larkana District, Sind in November 1929. At the time, neither I nor my party knew what a *rara avis* for those parts we had secured. I am now sending you this note for purposes of record. When brought in, the men turned it over and passed it round, but the most experienced *shikaris* could make nothing of it. I know that a few Nuktas have been seen and shot in Lower Sind but I believe I am right in assuming that this is the first recorded from Upper Sind, three whole degrees of latitude north of the Badin and Sujawal District.

GOVERNMENT HOUSE,
KARACHI.
March 23, 1932.

H. T. LAMBRICK, I.C.S.

[Ticehurst in his *Birds of Sind* (Ibis. 1923, p. 443) gives a few records of Nukta shot in Sind, all of them from the southern and eastern portions of the province. Most of these were obtained in the Sujawal District. The Sindhis call it *Karo Hang* (Black Goose). There is a specimen in the Society's collection shot at Umarkot on 26th December 1917.—EDS.]

XV.—OCCURRENCE OF THE BRONZE-CAPPED OR
FALCATED TEAL (*EUNETTA FALCATA*) IN KUTCH.

Yesterday my nephew shot a duck which we could see at once, was a new variety for Kutch.

We referred to two books viz. *Indian Ducks and their Allies* by Stuart Baker and *Indian Sporting Birds* by Frank Finn. There is no doubt to our mind that the bird is a Bronze-capped Teal. Still, to make quite sure, we are sending the bird to you for further identification.

Would you kindly confirm whether our identification is correct. Captain Lester's book *The Birds of Kutch* makes no mention of this duck.

It is all the more strange that in a famine year, when practically there has been no migration of duck in Kutch, such a new variety should occur.

THE PALACE,
BUJ-KUTCH.
February 8, 1932.

VIJAYARAJJI.

XVI.—OCCURRENCE OF THE BRONZE-CAPPED OR
FALCATED TEAL (*EUNETTA FALCATA*) IN BURMA.

I send herewith leg and wing of what I take to be the Bronze-capped or Falcated Teal *Eunetta falcata*. I have had this identified by you before from Shwebo, Xmas 1919, from Katha last year but always considered it a rarity. However this year I got 2 at Kyelagany (Katha) a fortnight ago and 3 more yesterday evening. The wing of the bird sent, being one of a bunch of 3 and my cook assures me that his dissection showed it to be a male and the other two, whose plumage was exactly alike, as females; however, his evisceration was so vigorous that I wouldn't like to swear to it. The birds looked more like small Pintail than like female Gadwall: but I had neither of these species in the bag to compare it with.

MAYMYO,
BURMA.
January 5, 1932.

C. E. MILNER.

[The birds obtained by Mr. Milner and H. H. Prince Vijayarajji of Kutch were identified correctly by the respective authors of the above notes. The Bronze-capped Teal ranges through Eastern Siberia, Manchuria and Mongolia. In winter it is found throughout China, Japan and the Indo-China countries, rarely in Burma and the Shan States and even more rarely in India.—Eds.]

XVII.—OCCURRENCE OF THE GOLDEN EYE
(*GLAUCIONETTA CLANGULA*) IN THE CHAMPARAN
DISTRICT.

I am sending under registered cover a duck skin for identification. From description I think it may be a female Golden Eye (*Glaucionetta clangula*). Would you kindly let me know?

The bird was shot about 20 miles away from Bettiah-Rahvia jheel on 10th.

RAJGHAT,
P. O. BETTIAH
CHAMPARAN.

January 12, 1932.

A. C. HARMAN.

[The bird sent by Mr. Harman was a male in eclipse plumage which is similar to the plumage of the female. The colouring of the wings is however retained and the pure white speculum serves to distinguish the male in this phase of plumage.—Eds.]

XVIII.—OCCURRENCE OF THE SMEW (*M. ALBELLUS*) IN SIND.

A Smew was shot by H. E. the Viceroy's Party this year. It was a male and fell to Capt. M. G. D. Clive, A. D. C. at Lung, taluka Kambur, January 14th, 1932.

GOVERNMENT HOUSE,
KARACHI.

H. T. LAMBRICK, I.C.S.

March 21, 1932.

[The Smew is not a common bird in Sind. It has been met with on the marshes, lakes and on the Indus at Kashmor—odd flocks appear occasionally in various parts of the country.—Eds.]

XIX.—COMPARATIVE FREQUENCY OF FANTAIL, PINTAIL AND JACK SNIPE NEAR BANGALORE.

It may be of interest to place on record the proportions of Fantail, Pintail and Jack Snipe shot in the immediate neighbourhood of Bangalore and examined by me during the seasons 25th November 1928 to 14th April 1929, and September 1929 and 16th March 1930.

		1928-29	1929-30
Fantail	...	137	164
Pintail	...	204	156
Jack	...	4	7

14, FIELD COMPANY,
Q.V.O. MADRAS SAPPERS
& MINERS, MANDALAY.
February 18, 1932.

E. E. G. L. SEARIGHT,
Captain.

XX.—DISEASE AMONG CROWS.

On August 3rd 1931, I wrote a letter to the *Civil and Military Gazette* in regard to the disease which destroyed a large number of crows (*Corvus splendens*). The disease has wrought havoc among the crow population. The House Crow is a common bird round Srinagar. In winter we used to see flocks of these birds in and around the houses in Srinagar. We sadly miss them now. Not

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more than a few pairs are to be seen where scores used to hover about.

C. M. S. HIGH SCHOOL,
SRINAGAR, KASHMIR.

SAMSAR CHAND KOUL.

January 29, 1932.

[The disease to which the writer refers appears to have affected the crows in various parts of India last year. It was prevalent in Bombay where numbers of crows were victims to it. The birds fell from their perches and lying a while helpless on the ground, died. The cause and nature of the disease was not discovered. Tests made at the Haffkine Institute, Bombay, failed to discover the presence of bacteria of any sort. Death among crows from similar causes was also reported from Madras, Mangalore and other towns in Southern India. The mortality over the whole range of the country must have been very high—but its effect on the crow population of Bombay is imperceptible. In Kashmir, where the Sind House Crow has managed to secure a foothold, the ravages of the disease in a comparatively small colony has been presumably more noticeable.—Eds.].

XXI.—MIGRATION OF WILD-FOWL.
THE SOCIETY'S BIRD-RINGING SCHEME.

Since the publication of the last recoveries in Vol. XXXIV No. 4 of the *Journal* the following recoveries of Ringed Birds have been reported to us, the first by the Forest Technical Officer, Tomsk, Siberia and the second by Mr. V. M. Ansari, Inspector of Salt Revenue, Suigam, N. Gujerat.

Place of Ringing.	No.	Date.	Species.	Ringed by.	Date of recovery.	Locality.	Re- marks.
Dhar State.	116	23-2-29	Teal ♂	Maharani of Dhar Series.	6-10-31	Near Vasuga- na R. Tomsk, Siberia.	
Manchar Lake ...	789	11-2-31	Shoveller ♀	R. B. Mac- Lachlan.	5- 1-32	Suigam, N. Gujarat.	

March 15, 1932.

Editors.

XXII.—TUCKTOO VERSUS DHAMAN.

(From the *Field*, 16th January 1932).

Most people who have been in Burma are acquainted with the 'Tuck Too', a large greyish lizard with numerous pink spots dotted all over the body. A frequenter of the vicinity of bungalows, he now

and then—particularly at dusk—gives vent to the little slogan from which he takes his name. At the end of each outburst he takes a deep breath which is distinctly audible, and to finish up with, qualifies his remarks with a long 'Ah', as if of satisfaction. The number of cries given is supposed to represent his age in years. Be that as it may, the Burmese have a healthy respect for his tenacious capacity, and avow that once he gets a grip he never lets go, so they give the gentleman a wide berth. Their belief is not unfounded, as will be illustrated by the following anecdote.

A friend of mine was sitting in his bungalow one morning when a scuffle on a rafter attracted his attention. On investigation he found a 'Tuck Too' and a rat snake in mortal combat. It appears that they approached each other along the beam in opposite directions and disputed the right of way. The snake struck out hard at his aggressor, but the redoubtable 'Tuck Too' was on his guard and deftly 'fielded' the snake's upper jaw in his mouth. Not to be outdone, the latter coiled himself round his opponent, and they both fell to the ground—a distance of 10 ft. The fall, however, was not sufficient to warrant a cessation of hostilities, and neither relaxed his grip to even the slightest degree.

At this stage my friend sent them along to me. I saw them about three hours later and there were no signs of surrender on either side. The 'Tuck Too' held on doggedly with his eyes closed, whilst every now and then the snake drew a deep breath and tightened his coils. An attempt at this stage to interfere in the fight was resented, and they both let go. The snake scurried off, leaving the plucky lizard *hors de combat*. Had I not interfered I am convinced they would both have succumbed. The snake was 3 ft. 6 in. long, and his opponent 11 in. from tip of snout to tip of tail.

SHWERO,
BURMA.

E. J. CURRAN, R.A.M.C.

[The large House Gecko (*Gecko verticillatus*), known as the Tucktoo or 'Tucktai' because of its loud call, is a common inhabitant of houses in Bengal, Burma and the Malay countries. Though lizards form the customary food of many snakes, the tables are occasionally turned. Some of the larger lizards, like the monitors, and the present species, which is the largest of Asiatic geckos, frequently feed on snakes. In vol. xvii, p. 1017 of our *Journal*, Colonel Wall gives an account of a fight between a Tucktoo and a 4' 6" Dhaman (*Zamenis mucosus*). The Tucktoo was the aggressor and the Dhaman bolted into a hole leaving a portion of its tail in the lizard's mouth. In the same issue there is a note by the same author on a fight between a Tucktoo and a Golden Tree Snake (*Chrysopelea ornata*). The fight was a desperate one; the lizard held the snake some inches behind the neck in a vice-like grip. On being thrown into the sea the combatants separated for a moment and then renewed the struggle in the water.—Eds.]

XXIII.—THE FAT-TAILED LIZARD.
(*EUBLEPHARIS HARDWICKII*).

I am sending to-day, per registered parcel post a specimen of a lizard found by me in the Sohelwa forests, Bahraich district, for favour of identification.

The lizard was presumably hibernating inside the loose bark of a dead *Sal* (*Shorea robusta*) tree and fell down when the bark was removed. It hardly made any attempt to run away.

I saw this same kind of lizard once before (last year) in identical circumstances but I have never seen one crawling about even in the hot weather. The lizard therefore is either extremely rare or extremely shy or nocturnal in its habits or lives on top of high trees. I purposely do not mention burrows in the ground because none have been found in cuttings made for forest roads.

I shall feel obliged if you will kindly let me know its scientific name.

You may do what you like with the specimen.

CAMP VIA SEMRA,
P. O. PACHPERWA,
DIST. GONDA, U. P.
February 16, 1932.

J. N. ONIAL,
Range Forest Officer.

[The lizard sent is an example of the Fat-tailed lizard (*Eublepharis hardwickii*); a species closely connected to the geckos from which it is distinguished externally by the possession of moveable eye-lids. Two species occur in India. *E. macularius* is found in the dry regions of the Punjab, Sind, Gujerat and the Deccan. The present species occurs in Central India, the United Provinces and Bengal. Of the two, *E. macularius* appears to be more common; it is more in evidence perhaps because of the open nature of the country which it lives in. It is entirely a ground lizard feeding on insects. A specimen lived in captivity in the Society's rooms for about 11 years. Nothing is known of the habits of *E. hardwickii*, and Mr. Onial's note is therefore of interest. It is possible that this lizard hibernates, or becomes sluggish during the cold weather. The Common Blood-sucker (*Calotes versicolor*) displays the same habit.—Eds.].

XXIV.—SOME NOTES ON WATER MONITORS IN THE
GARO HILLS, ASSAM.

Water monitors are fairly common in the rivers of the Garo Hills especially in the Simsang or Someswari. Garos distinguish three varieties which they call *Aringga*, *Matphu* and *Phusil*. Speaking generally, they refer to all three as *Aringga*. Though several young monitors have been brought to me alive, I have never seen a full-grown specimen in the Garo Hills. The only difference I could see in the specimens brought me was that the markings varied. *Aringgas* have very clearly defined yellow spots, while *Matphu*

and *Phusil* had rather more clouded yellow markings. *Matphu* and *Phusil* are said to be dangerous animals which drag men under water and suck their blood. Garos however tell me that all three come into the fields to eat melons, cucumbers and the ears of paddy, which does not fit in well with their alleged vampirish propensities. *Aringga* according to Garo legends is a kindly beast and the friend of Man. I have heard many tales of people who are said to have been killed by water monitors but have never yet found a case which can be regarded as authentic. At Rongrenggiri, there is a deep pool in the Simsang River, said to be inhabited by these lizards and I was told a long story about a woman, who was dragged out of a boat, as she was crossing the river with a party, returning home after celebrating the Wangala feast in another village. Investigation showed that most of the party were suffering from the effects of too hearty celebrations and that the probability was that the unfortunate lady had merely fallen into the river and been drowned. During the two periods I was stationed in the Garo Hills, I have heard quite a number of similar stories in all of which, however, the case against the monitor proved to be based on the flimsiest foundations. None the less, Garos are firmly convinced that water monitors are most dangerous animals, and both fear and revere them, regarding them as not far removed from water spirits. Carved figures of *Aringgas* are to be found on the Bachelor's Houses of the Atong and Ganching Garos and the Dawa clan of Garos is descended from a man called Dawa who was a friend of the *Aringga*.

The only full-grown water monitor that I have seen was in the Kolodyne river in the Lushai Hills. It was sitting on a rock and slid off into the water as my boat approached. Lushais do not fear monitors nor have they any legends about them. This is possibly because Lushais do not build their villages on the banks of the rivers; while the Atong and Ganching Garos all live on the river banks.

The legend of Dawa and the *Aringga* is as follows:

Once upon time a young man called Dawa caught a little *Aringga* which was feeding on the melon flowers in one of the village fields. He put the little *Aringga* into a cage and gave it melons and other fruits to eat. Meanwhile the parents of the little *Aringga* came to visit their child in captivity every day. When Dawa saw these two large *Aringgas* come to his house daily, he thought that they must be the father and mother of his captive and, knowing that the home of the *Aringgas* was the river, he became very afraid lest, when he was in a boat or swimming in the river the *Aringgas* should take vengeance on him or on his people because he had captured their child. Dawa therefore decided to release the little *Aringga* but, before doing so, in order to please its parents he placed earrings in its ears and dressed it in a yellow coat. Then he made a solemn promise to the *Aringga* never to catch any Monitors, again and begged the *Aringga* on his part not to try to kill any man swimming in the water provided that he called out 'I am a son of Dawa.' After this Dawa released the little *Aringga* who became his friend and used to carry Dawa across the water on his back. Since then the *Aringga* has been the friend of man. To this day, Garos when

swimming in a river or crossing a river in a boat, call out 'I am a son of Dawa', they also never try to kill *Aringga* and, if a Garo catches an *Aringga*, he puts rings in its ears and releases it.

Another story explains why carvings of *Aringga* are found on Bachelor's Houses (Nokpante).

Once upon a time two young men called Aning Krang Ratcha and Chanang Gitting Pante built themselves a Bachelor's House in the Lower Regions and passed their time in it very pleasantly drinking wine, playing drums and singing about old times. One day a mortal, called Demarachi Mande Jagitang who dwelt upon the earth, heard the sounds of singing coming as it seemed from the Lower Regions and tried to find out whence the sounds were coming. When he listened carefully the sounds which at first had seemed to come from below the earth, appeared to come from the sky and when he thought the sounds were coming from the sky and consequently listened in that direction, the sounds again seemed to come from below the earth. At last a man called Katchipa succeeded in pulling aside the screen separating the earth from the Lower Regions and saw inside the earth a huge Bachelor's House from which came the sounds of singing and merriment. Katchipa persuaded the people to build a similar bachelor's house on earth and taking with him Dingara, Radinga, Rinda and Sindato went to a blacksmith who had learnt how to make *daos* and axes from Rohon Pante the blacksmith of the Lower Regions. Having obtained all the tools they required from Rohon Pante, they collected wood and bamboos and thatching grass and built a Bachelor's House. On the cross beams of this first Bachelor's House they carved figures of the *Aringga* of the Lower Regions and of Sangkni of the deep waters, a water snake. Menpa and Radinga painted these figures in colours and since then Garos have always carved figures of *Aringga* and of Sangkni on their Bachelor's Houses.

COOMBE FISHACHE HOUSE
IPPLEPEN, S. DEVON.

N. E. PARRY.

December 4, 1931.

[Two species of monitor are known to occur in the area about which Mr. Parry writes, the Common Monitor, [*Varanus monitor*, (*bengalensis* of Boulenger)] and the Water Monitor (*V. salvator*). The young of both species are handsomely marked with more or less distinct ocelli arranged in bands which disappear with age; though in the Water Monitor, the yellowish markings on the belly and the lower flanks are noticeable even in adult specimens—while the adult Common Monitor is generally a drab grey. In India, the young of the Common Monitor is commonly believed to be deadly poisonous and with a few other, equally harmless lizards, is associated with the mythical 'Bis Cobra' which is said to poison people from a distance of many feet. None of our Monitors is poisonous. Their jaws, armed with pointed teeth, can inflict a painful bite, while the muscular tail vigorously lashed out makes an effective weapon.—Eds.]

XXV.—NOTE ON THE FASCIOLATED RAT SNAKE
(*ZAMENIS FASCIOLATUS*).

(A correction.)

I wrote a note in vol. xxxiv, No. 4, of 2nd March 1931 of the *Bom. Nat. Hist. Soc. Journal* on a specimen of the Snake, *Zamenis fasciolatus*, seen at Ahmednagar in January 1930. It was stated therein that 'Boulenger, however, mentions that *Zamenis fasciolatus* may grow to 8 ft. 5 ins.' This statement was made from some old notes I had with me. On referring to Boulenger's book in the Society's library I find this statement is incorrect. Boulenger states it grows to only 3½ ft. with a tail of 8·5 ins. So this specimen of *Zamenis fasciolatus* killed at Ahmednagar, being 4 ft. 8 ins. long, is a record one.

BOMBAY.
March 5, 1932.

K. G. GHARPUREY,
Lt.-Col. I.M.S.,
Civil Surgeon, Ahmednagar.

XXVI.—CANNIBALISM AMONGST COBRAS.

On the morning of February 3rd, a Cobra while in the process of swallowing another snake was killed in my compound.

I took the enclosed snap-shots before and after the partially swallowed snake was withdrawn, and much to my surprise found the partially swallowed snake to be one of the same species.

The length of the big snake was 4 ft. 9 inches.

The length of the small snake was 3 ft. 6 inches.

TRICHINOPOLY.
February 15, 1932.

A. D. HICKIE.

[The snap-shots were insufficiently clear for reproduction.—Eds.].

XXVII.—A NOTE ON THE FISHING INDUSTRY AT
DANDA.

(With a plate.)

This village, with a population of about 400, is entirely dependent for its existence on the fishing industry. It is fortunate in having an educated and able *Patel* in Mr. Motiram, to whom we are indebted for much information and assistance. He is himself a part-owner of a fishing boat.

There are three types of sailing craft in use at Danda, all of which are constructed in Danda by boat-building carpenters who are called in when a new boat is required.

The types of sailing craft in use, and the methods of fishing are :
1. Sailing dug-out canoes, fitted with outriggers; costing from Rs. 150 to Rs. 300 according to size. These boats are manned by 3 men. They are not subject to the same restrictions as the larger boats, and often go out amazing distances, remaining at sea for four or five days. The method employed is to trawl, only the more valuable fish caught being kept.

Journ., Bombay Nat. Hist. Soc.



One of the large boats at Danda.



One of the Danda boats about to set out for the fishing grounds.

2. Boats costing from Rs. 400 to Rs. 600 each. These boats carry a crew of 4 men and they fish at from 5 to 7 miles distance from the shore, employing the *stake* method of fishing, described later, or more commonly the floating net moored to buoys at the ends, distended by the flow of the tide; the net being put out at high tide, and taken in with its catch just before the next slack water. As opposed to the *stake* method the net does not reach the bottom, being only 10 to 15 feet wide.

3. Boats costing from Rs. 800 to Rs. 1,000 each, manned by 9 men. Each boat has its own fishing ground and at the beginning of the season, September or October, the ground is prepared by driving into the bed of the sea 2 stakes, i.e. very smooth laminated timber stakes, composed of carefully selected and spliced timber; care being taken that the finished stake has no projections to foul the nets. Each stake is 60 to 70 feet long, 12 in. to 18 in. in diameter, pointed and heavily weighted at the bottom, with a grooved or slotted top and also a slot at the bottom just above the sea bed, and costs from Rs. 400 to Rs. 500. The stakes are driven or lowered into position by the fishermen from between two boats about 60 to 70 feet apart.

The usual practice, is for each boat to have four stakes. The stakes are left in position until May or June and then brought in for the monsoon. The nets used are of the purse type, the mouth of the net being attached to the stakes top and bottom, i.e., at the four corners of the net by ropes.

After this preliminary description of the boats used and methods of fishing, we will now describe an actual trip on one of the larger boats.

The following is an account of a trip with the fishermen in one of the larger boats:—

On the 3rd of February we went for a trip with the fishermen of Danda in one of their flat-bottom boats of the larger variety, with a crew of nine men. We set out at 9 a.m. with a mild wind behind us and reached our destination, some 12 miles out at 1 p.m.

The tide was on its way out so we waited till 5-30 p.m. when the two nets carried were cast and attached to the stakes. At 11 p.m. the nets were dragged up and we set sail for the village, reaching it at 9 a.m.

As soon as the boats set out, the men ate their food and settled down to sleep until the spot where the stakes are placed was reached. When the boat was fastened to one of the stakes, the sail was lowered, the mast was laid alongside it on two Y-shaped pieces of wood, and the men proceeded to mend their nets till 5-30 p.m. when it was time to cast them. Each net is tied between two stakes, and just at low or high water it is lowered into position (as the tide runs in or out it drags the net in the direction in which it is going). This done, the boat is placed directly over the net.

The men then ate their dinner and slept till 11 p.m., when they drew in the net, roughly sorted the fish, repeated the performance of casting their nets, extracted the fish from the opening at the purse end, which is normally tied up when fishing, and went to sleep till 4 a.m. Then, awaking, they dragged in the net and headed in the direction of the village.

Immediately the boat arrived, the womenfolk came alongside in small *Dinghies* and took the fish away in baskets.

The catch consisted of 7 Goals (*Sciana*) (large fish), about 1 dozen Pomfrets (*Stromateus cinereus*), 1 dozen Halwas (*Stromateus niger*), 100 Waghtis (*Chirocentrus dorab*) and 10 Baskets of fish of various kinds.

In the estimation of the head fisherman, the value of this catch was about 40 to 45 rupees, which was the average price realised for a catch.

After the fish were taken away, the fisherman proceeded to dry their nets, as, if this is not done, they rot due to the corrosive action of the water; this is one of the reasons why they do not remain out at sea for longer periods than 24 hours.

The smaller fish are cured at the village.

When we first arrived, we were impressed at the amount of fish being dried, and at first it was thought this was for commercial purposes, but later we learned that this was done in order to provide food for the families during the Monsoon months.

On an average there are about six owners to each of the larger boats, some of whom fish themselves; others hire a crew. The boats are not insured as, even if they capsize or get swamped, they float.

BOMBAY.

February 16, 1932.

GORDON L. CAMERON,

C. L. CURZAI.

XXVIII.—THE GIANT LOCUST (*SAGA EPHIPPIGERA*).

There is not a great deal known by people of Iraq about this Giant Locust.

In Iraq they are usually found as solitaries; even hatchings from one egg-pocket do not keep together during the hopper stage.

The Inspector General of Agriculture has furnished me with the following note which may be of interest to you:

‘ Its life history so far as we know it, is as follows :—

Eggs hatch in early April. The larvæ go through an undetermined number of moults, and finally become adult wingless locusts about mid-May. They are omnivorous during their larval and adult life, but seem to prefer the hoppers or the adult Moroccan locust as food.

Egg capsules are nearly always found near breeding grounds of the Moroccan locust, and are always single pods inserted into the ground by the side of a stem of “Shok” or some other plant.

The immature hoppers show no tendency to swarm, but split up as soon as hatched.

Egg-laying occurs about June and after this the adults appear to die off, and no further specimens are seen until the following April when the eggs hatch again.

From the fact that this locust is confined to those areas in which the Moroccan Locust appears annually, and from the fact that egg-pods are usually found on breeding grounds of that same locust, I

incline to the view that the *Saga* in this country may be considered as a parasite of the Moroccan Locust.'

OFFICE OF THE DIRECTOR OF J. RAMSAY TAINISH,
RAILWAYS, BAGDAD. *Lt.-Col., Director of Railways, Iraq.*
January 9, 1932.

[Lt.-Col. J. R. Tainish recently presented the Society with a specimen of this Giant Long-horned Grasshopper, and the above note is in response to our enquiry for further information about this remarkable looking insect. On dissection the insect proved to be laden with eggs.—EDS.].

XXIX.—TERMITE FUNGI.

(*With a photograph.*)

It is a well-established fact that termites are in the habit of growing fungi in specially prepared 'Fungus Gardens' but it is an open question as to whether the termites at any time allow or encourage the fungi to spore. As far as is known, the fungi grown in termite nests are never allowed to fructify within the nest. If this state of affairs was to continue year in and year out, it appears to me that there would be a likelihood of the particular species of fungus being exterminated in the course of time. The question is, *Do the termites do anything to avoid this?* A vital question intimately connected with their very existence.



Some years ago when collecting fungi for Professor S. R. Bose, of the Carmichael Medical College, Calcutta, I came across a termite mound covered with a small fungus as is shown in the accompanying

photograph. Every portion of the outside of the mound, even isolated cones, were covered with it. On examination of the mounds, it appeared to me as though the termites themselves were responsible for this luxuriant growth of fungi. The bed on which the fungi grew was to all appearances composed of the same material of which their fungus gardens were constructed. This layer of material was super-imposed over the reddish earth of which the mounds were made. This is the first instance of this nature I have seen in all the many years I have roamed the jungles of Salsette Island.

The termite mound in question was at the time of this discovery inhabited. On digging up part of the mound I found there were still a few 'Fungus Gardens' within the nest, but it was hard to say, with certainty, whether some of the large cavities were formerly occupied by 'Fungus Gardens', and had now been emptied of their contents. This observation was made during the monsoon. The next year I visited the same mound at about the corresponding time. There was not a trace of fungi to be seen. The nest was still inhabited and only the bare earth formed the outside of the mounds. Since that time I kept an eye open for such instances but have not come across anything of the kind. Now the question arises as to whether the termites collect the spores and take them inside the nest once more along with the humus on which the fungi grew? This of course is an open question. The fungi grew so thickly on the mounds that I have no doubt that the humus below them must have been very abundantly covered with the spores, as the wind could not have blown the lot away during this season, and in such a spot. It is hard to believe that the termites did this deliberately with a view to replenishing their 'Fungus Gardens' but this casting of the old 'garden' material may have been brought about by the fact that it was of no further use, being unfertile, and was cast in consequence. Probably the mould contained sufficient fungus material to enable it to fructify, after which it was once more of great value to the termites. The termites finding this to be the case later on, probably transported it back to the interior of the nest once more. To credit the termites with such forethought would be out of the question and this end was in all probability achieved accidentally. In the first place the material was put on the outside of the nest in order to consolidate it as is the wont of termites during the hours of darkness, with earth from the interior, then later on finding that the outside of the nest was covered with vegetable material, which is valuable to them took it within once more. It is also a well-established fact that termites keep the outside of the mounds clean and finding that the outside of the mounds was covered with valuable food material, took the fungi back into the nest.

BOMBAY NATURAL HISTORY SOCIETY,
6, APOLLO STREET, BOMBAY.

January 14, 1932.

C. MC CANN, F.L.S.
Assistant Curator.

XXX.—NOTE ON *ZESIUS CHRYSOMALLUS* HUB.

Larva and Pupa.—In my note on this butterfly in my list of 'The Butterflies of Coorg,' I made the dogmatic statement that this insect has its larval and pupal stages in the nests of yellow tree-ants. On further investigation I find that this statement requires modification. Here I must express my indebtedness to Capt. N. D. Riley of the British Museum and to Mr. G. M. Henry, Entomologist of the Colombo Museum.

I based my statement on information given me concerning the habits of the insect in Ceylon. Capt. Riley, however referred, me to Ormiston, *Butterflies of Ceylon* p. 69, and to Bell, *Journal, Bombay Nat. Hist. Soc.*, xxvi, No. 2, p. 456. 1919. I quote the references:

1. 'I have found the pupa on the stem of an *Albizzia moluccana*. The larvæ are always attended by the large red ant, and the perfect insect may be looked for wherever these ants abound.' (Ormiston).

2. 'Eggs never laid on any tree that has not got red ants on it. Larva is constantly wandering about from leaf to leaf, and is extremely restless, a cannibal in its habits, as it will eat any of its kind that may be changing its skin or pupating. Pupation takes place on leaves. The caterpillars make leaf-cells or houses like those of the genus *Arhopala*.' (Bell).

I then wrote to Mr. G. M. Henry, who, I had been told, had obtained perfect specimens by taking the pupæ from the nests of the red (or yellow, as I called it) ant. He very kindly gave me the following information:

'The caterpillar, in Ceylon, feeds on the young leaves of various trees, notably the cadju-nut (*Anacardium occidentale*) and is always attended by red ants (*Ecophylla smaragdina*), but it does not necessarily live in the nests of the ant—although I am inclined to think that it returns to these when not feeding, etc. It does, however, almost invariably, I believe, take refuge inside the ants' nests for pupation, and it was by searching these that I was able to obtain pupæ and so rear perfect specimens.'

'The nests of *Ecophylla* are generally made among mature leaves, which do not suit the larva of *Zesius*, and so I am doubtful whether it customarily feeds inside the nests: but it certainly has no fear of the ants and enters their nests with impunity.'

From these quotations the following facts and questions emerge:—

1. The larva is attended by red ants, among which it lives. Whether it is looked after by the ants for the sake of a secretion in honey glands, has to be investigated in the field. Also, is it to be found in the nests?

2. Are the Indian ants the same as the Ceylon *Ecophylla smaragdina*? or do other species protect the larva of *Zesius*? The nests are made among the mature leaves—I am doubtful however if, round Bangalore, only mature leaves are used—of various trees and shrubs, *Albizzia moluccana*, *Anacardium occidentale*, *Eugenia jambolana*, mango, matti (*Terminalia tomentosa*) etc.

3. The pupa has been found on the stem of *Albizzia moluccana*, in leaf houses similar to those of *Arhopala (amblypodia)*, and in

Ceylon, almost invariably, inside the nests of the red ants. It would appear to have no uniform place of pupation.

Seasonal variations.—I regularly visited one patch of jungle reserved for sandal, in the Koramangala Reserve Forest, 28 miles from Bangalore, for the sake of this insect. It was rare or did not occur in many other patches of jungle that I visited, but in this patch, consisting mostly of low and bushy growth, with few scattered trees, it was to be had, quite plentifully in some months, throughout the year. From an examination of a large number of specimens, there emerged the fact that I have not seen noticed in books, that there are very definite wet and dry season forms, with intermediate forms, and very great individual variation, especially in the colouring and distribution of the bands and red spots below.

1. *Dry season form.* Approximately from January to early May. The extreme D. S. F. occurs in the latter end of March and in April, i.e., the driest period.

♂ Light coppery red : the violet gloss (*vide* Evans) scarcely visible ; the fuscous border narrower than in W.S.F. Below much paler grey than in W.S.F., spots very variable ; faint, often little or no red visible, or red spots only at base *fw* and *hw*.

♀ Above pale chalky blue ; borders brown. Below very variable : spots and visceral bands faint, often only just visible on whitish or chalky ground. Red spots as on ♂ either not apparent or only at base. Often not more than one spot reddish.

2. *Wet season form.* Approximately June to December. Transitional forms in May and November-December. But there is no fixity about the changes, and the gradation from wet to dry and from dry to wet goes on throughout the year. Darkest above and below from about July to September.

♂ above deep coppery red ; violet gloss distinct. Fuscous border broader, especially at apex, than in D.S.F. Below, deeper grey ground, in darkest forms with a reddish tinge. Markings all distinct with dark enclosing edges. Red in spots variable ; in some cases up to discal band ; most distinct at base and across cell, but in some cases limited to base of cell *fw* and *hw*.

♀ Blue *upl* and *uph* much deeper than in D.S.F. almost electric blue. Below not so dark as ♂ as a rule or without the reddish tinge but deeper grey than in D.S.F., with markings up to sub-marginal band all clearly defined. Sometimes as in ♂ red or reddish up to discal bands. Sometimes red completely absent or present only in spot at base.

Miscellaneous.

1. ♂♂ have only two tails. ♀♀ have three, one very short tail above notal spots, with two longer tails below.

2. One form of ♀ has no blue above or only a faint trace of blue on dark brown near base. This form I took in wet forest in Coorg, and I notice that similar specimens in the British Museum come from near Karwar, W. Kanara. Is this form a wet area form ? In the drier jungles of the Mysore plateau, I saw no ♀♀ approaching this form.

3. ♂♂ are often quasi-gregarious in their flight. Half-a-dozen or more will fly about one bush or branch, chasing each other. ♀♀

seem to go about their business singly, and more sporadically on bushes through the jungle.

BERKHAMSTED

J. A. YATES.

HERTS, ENGLAND.

February 2, 1932.

[Since writing the above, Mr. Henry has kindly written to me:— 'Your query whether the caterpillar is "looked after by the ants for the sake of a glandular secretion" may be answered in the affirmative, as the ants may constantly be seen crawling on and about these caterpillars and licking a dorsal gland.' J.A.Y.]

XXXI. 'BUTTERFLIES OF LAHORE.'

I have been favoured with an advance copy of Brigadier W. H. Evans's Note on my paper on the 'Butterflies of Lahore' (Bulletin of the Department of Zoology, Punjab University, Vol. I, pp. 1-61, pl. I-IV, April, 1931). The note itself has since appeared in the Journal of the Bombay Natural History Society (Vol. XXXV, No. 3, p. 667, 15th Feb. 1932). I have re-examined my specimens in the light of his criticism, but can only confirm the names already given in the paper.

Comparatively little work has been done on the butterflies of the Punjab plains, and it should not, therefore, be surprising if some forms of which there is no previous record from this region are subsequently discovered.

Many species of butterflies are known to occur on the hills as well as on the plains, whilst others are even cosmopolitan in distribution. That *Aporia soracte* and *Ypthima narceda* are 'Himalayan insects not occurring below 5,000 feet' only means that the two species have not previously been recorded from the plains, but does not necessarily preclude their occurrence at lower altitudes. As a matter of fact the latter species has already been recorded by F. Hannyngton to be 'Common at 2,000-7,000 feet' in the vicinity of Naini Tal (Jour. Bombay Nat. Hist. Soc., 1910, p. 136). Recent investigations in America by means of aeroplanes show that an insect may be found as high as 14,000 feet from its place of abode. Thus the cotton leaf-worm moth (*Alabama argillacea*, Hb.) usually occurs upto 3,000 feet, and the cotton flea-hopper (*Psallus serialus* Rent.) upto 5,000 feet. Such insects as leaf-hoppers occur upto 7,000 feet, and minute parasitic flies, Aphids, etc., upto 14,000 feet (Year-book, U.S.A., Department of Agriculture, 1931, pp. 320-323). A more intensive work would probably show that there are several more species of butterflies so far recorded only from the hills, which occur also on the plains. *Argynnis aglaia*, which Brigadier Evans regards as 'A European butterfly which only reaches the Indian Empire in Chitral and the countries nearby, flying at over 6,000 feet', is now known to be comparable in distribution to species like *Melitaea didyma*, a European butterfly, which has actually been recorded from Chitral and the Punjab (Antram, 'Butterflies of India', 1924, p. 201). Nor is the occurrence of *Araschnia levana* in India unparalleled, since a single specimen of *Argynnis maia*, a European species, has been recorded from probably near Gilgit (Bingham, Fauna of British India, Butterflies, Vol. I, 1905, p. 435). It may also be noted that I have

obtained in Lahore only one specimen of each of the four species, which according to Brigadier Evans do not occur in that locality.

G. W. V. de Rhe-Philipe's paper on 'Butterflies of Lahore' was published twelve years ago, and since then *Mycalesis perseus*, *Terias venata*, *Catachrysops cnejus* and *Aphnaeus ictis* have actually made their appearance in Lahore, as was indeed predicted by that author. In addition to these I have obtained specimens of several other species hitherto unknown in that locality. Further, species which de Rhe-Philipe regarded as rare in Lahore, viz., *Delias eucharis* and *Euthalia garuda* (of each of which only one specimen was obtained by him) are now found to be common.

Under each species the more important references are given so as to aid others, particularly beginners, who may undertake a serious study of the butterflies of Lahore.

So far as I know, the cases of mimicry and protective colouration mentioned in my paper have not been previously recorded.

The four coloured plates at the end of the paper should be helpful to young collectors in identifying butterflies whose colouration has great specific value.

The specimens that I have collected from Lahore and described in my paper are kept in the Museum of the Department of Zoology, Government College, Lahore, and are available for examination by any serious worker.

GOVERNMENT COLLEGE, LAHORE.
March 19th, 1932.

D. R. PURI.

Brigadier W. H. Evans has written the following comment on Mr. Puri's note.

I have read Mr. D. N. Puri's Note dated the 19th March 1932 and regret that I cannot modify my previous remarks, except to the extent of admitting that an insect like *Ypthima narenda* might be found occasionally as low as 2,000 feet in the Himalayas, but it certainly is not a butterfly of the plains of the Punjab.

As I have left India for good I shall be unable to visit Lahore to see Mr. Puri's collection, but I do not think that an inspection is needed. It is always possible for a butterfly to be imported and released anywhere, but, barring this eventuality, I can assert definitely that *Aporia soracte*, *Ypthima narenda*, *Argynnis aglaia* and *Araschnia levana* can no more be found in the wild state in Lahore than the Kangaroo or the polar bear. Incidentally there is the question of the foodplants: if Mr. Puri will look these up, he will find that they do not occur in Lahore and a butterfly cannot exist away from its foodplant.

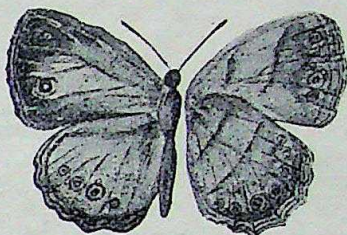
Mr. Antram's record of *Melitaea didyma* from the Punjab is certainly incorrect: the butterfly concerned is *Melitaea trivia*.

The species quoted as having, 'made their appearance' in Lahore or which are 'now found to be common' have doubtless existed there for centuries under much the same conditions. Butterflies are sometimes common one year and not to be seen in other years or they may be common in one small locality and absent elsewhere. The fact that Mr. Rhe-Philipe missed certain species or found them rare is not a matter for surprise nor an indication of their subsequent introduction.

XXXII.—*MYCALESIS ANAPITA*, MOORE.

(With a text figure).

A ♂ and ♀ taken in the TaVoy District, Burma, by Mr. W. L. Palmer and presented to me. This species has hitherto not been recorded within Indian limits, though it occurs in Siam; Malay Peninsular; Borneo; Sumatra; Banga and Billiton. The ♂, on upperside, is bright fulvous, heavily shaded with black on margins of forewings. The ♀ is much duller, as the fulvous portions are covered with fuscous scales. Underside dull fulvous; the two discal fasciæ and sub-marginal bands, dull rufous. The figure is by Miss Beryl Moses, of Dehra Dun. The ♂ was identified for me by Brigadier W. H. Evans, C.I.E., D.S.O.

*Mycalesis anapita* (Moore) ♂.

DEHRA DUN, U. P.

February 6, 1932.

O. C. OLLENBACH,

F. E. S.

XXXIII.—A *PLANTAGO* NEW TO THE BOMBAY PRESIDENCY.

During a certain investigation of adulteration of seed in 1924, Mr. G. B. Patwardhan of the Poona College of Agriculture found a *Plantago* in the Cumin crop (*Cuminum cymium* Linn). The plant was sent to me for identification. It turned out to be *Plantago exigua* Murr. As Cooke does not mention it in his *Flora of Bombay*, I append its synonymy and description.

Plantago exigua Murr. Conn. Gott. (1778) 94, t. 5.—*P. pumila* Linn. f. Suppl. 131; Boiss. Fl. Or. iv, 891.—*P. rosetana* Poir. Dist. Suppl. iv, 433.

A small annual glabrous herb. Stems slender from a decumbent base, erect, flexuose, branched. Leaves subulate-capillary, elongate, somewhat revolute, often hirsute at the base. Spikes ovoid or subglobose, few-flowered, minutely puberulous. Bracts from a large base, subulate, the lower ones as long as the spike, the upper ones longer than the calyx. Calyx-lobes oblong-lanceolate, slightly obtuse. Corolla-lobes ovate-lanceolate, acute.

Hook. f. (in Fl. Brit. Ind. II, 708) thinks this is a form of *P. psyllium* Linn. or of *P. stricta* Shousb. *P. psyllium*, however, can be distinguished by the linear-lanceolate to linear leaves and by the acuminate, calyx-lobes; *P. stricta* by the leaves being linear to lanceolate, and by the lanceolate to lanceolate-linear bracts. In addition, the plant is minutely pruinose above and papillose hairy at the joints.

P. exigua is indigenous in Afghanistan and Egypt. If it is mentioned for N.-W. India this is due to the fact that Royle raised the plant from seed bought in the bazaar.

PANCHGANI.

March 2, 1932.

E. BLATTER, S.J., Ph.D.

XXXIV.—*PUCCINIA HELIANTHI* SCHWR. SYD.
A RUST FUNGUS ON THE SUN FLOWER.
(*HELIANTHUS ANNUUS*)

(With a diagram).

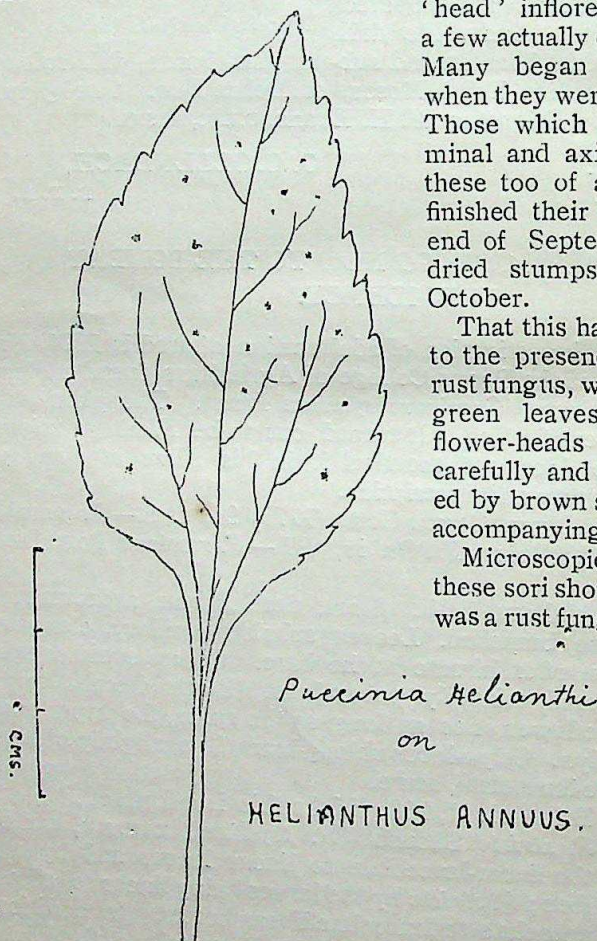
A few Sun flower (*Helianthus annuus*) seeds were sown in the College garden in June 1931. By August, the plants were about three to four feet in height. With this rate of growth it was expected that in about two more months' time these would be about five to six feet in height, the stem terminating in a large

'head' inflorescence. But only a few actually exceeded four feet. Many began to wilt and dry when they were hardly three feet. Those which produced the terminal and axillary 'heads' and these too of a very small size, finished their life-history by the end of September and became dried stumps by the end of October.

That this had occurred owing to the presence of a disease—a rust fungus, was clear when a few green leaves and the young flower-heads were examined carefully and found to be covered by brown sori, as seen in the accompanying figure.¹

Microscopic examination of these sori showed that the disease was a rust fungus in its uredo and teleuto stages.²

On an inquiry with the Imperial Mycologist, Pusa² it is learnt that the rust is *Puccinia Helianthi* Schw. Syd., previously reported to occur on *Helianthus licantherus*.³



¹ The dots on the leaf represent the sori.

² I am thankful to the Imperial Mycologist, Pusa, for the help he gave to me. S. A. P.

³ Ref. Sydow; Monographia Uredinarum, vol. i., p. 92.

It can be said, therefore, that *Puccinia Helianthi* Schw. Syd., occurs on *Helianthus annuus* as well, and that it probably results in considerable damage to the host.

BIOLOGY DEPARTMENT
RAJARAM COLLEGE,
KOLHAPUR CITY.

S. A. PARANDEKAR,
M.Sc.

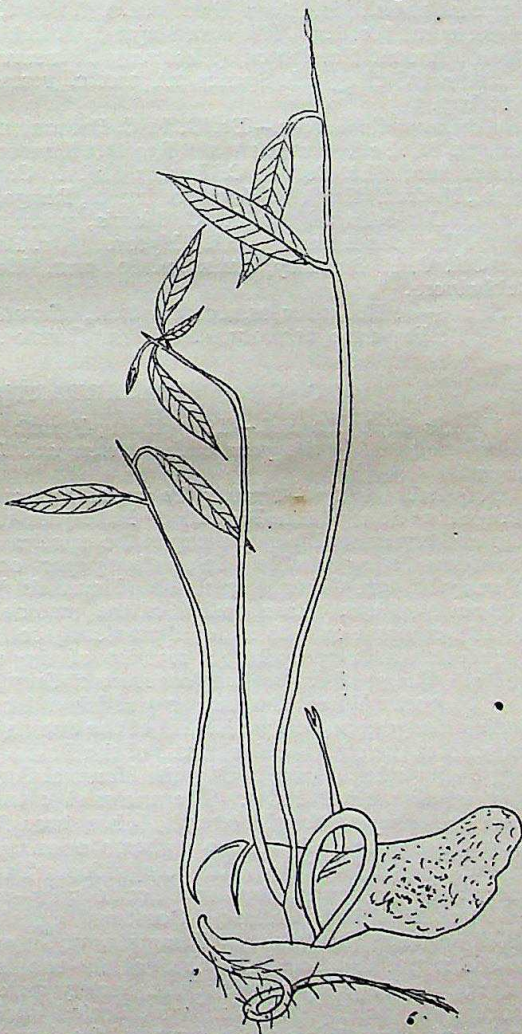
March 2, 1932.

XXXV.—COTYLEDONARY VEGETATIVE REPRODUCTION IN MANGO (*MANGIFERA INDICA* LINN.).

(With a diagram.)

The germinating embryo was collected from the Royal Lakes, Rangoon. It was growing in a shady place. The endocarp was ruptured and part of the cotyledons projected out. The whole measured 75.0 mm. and the projected portion was 35.0 mm. Four embryonic shoots were given off from the part just near the endocarp and one from the extreme part of the cotyledons. The tip shoot had its own roots system while the others did not have any separate systems.

Such a method of cotyledonary vegetative reproduction in *Mangifera indica* Linn. does not appear to be very rare, as a few others were collected from other localities, but the number of embryonic shoots was different—the described one had the maximum number.



UNIVERSITY COLLEGE,
RANGOON.
December 17, 1931.

L. P. KHANNA, M.Sc., F.L.S.

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR ENDING 31st DECEMBER 1931.

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Staff.—S. H. Prater, M.L.C., C.M.Z.S., (*Curator*). C. McCann, F.L.S., and V. S. La Personne, M.B.O.U. (*Assistant Curators*).

HONORARY SECRETARY'S REPORT.

The Society's Journal.—The Thirty-Fourth Volume of the Journal was completed during the year under review and 2 parts of Volume XXXV were issued.

Scientific papers.—Among the important papers on Mammals was Mr. R. I. Pocock's 'Study of the Pig-tailed Macaques (*Macaca nemestrina*)' in which the author revises the synonymy of the species and defines the races which he considers distinguishable. In another paper on the 'Scientific Results of the Vernay Eastern Ghats Expedition (Mammals)', Mr. Pocock deals with the Bonnet Monkeys. Examination of the material collected during this Survey and its comparison with material previously collected has brought to light some new facts which necessitate a revision of the species occurring in Southern India. The southern and eastern races of Grey Langurs are also dealt with in this Report. When the author published his Monographic Revision of the Indian Langurs in Volume XXXII of the Society's Journal there were no specimens from the south-eastern areas of the Peninsula to compare with the large range of specimens obtained by the Mammal Survey in the central, western and southern districts of India. The material obtained in the Eastern Ghats is therefore of exceptional interest. It has brought to light new local races and shown that some of the forms hitherto nominally recognised were based on characters not deserving that recognition. Two distinct local types of Grey Langurs are now recognised from South India—a pale-limbed form (*P. entellus gallipes*) from the Coromandel Coast and a darker Ceylon race (*P. e. thersites*) which occurs in Travancore. Examples of Grey Langurs from the Nilgiri Hills are still required to decide to which of the two forms the Grey Langurs of this hill range belong. Members of the Society residing in this area could help in deciding this point. The Monkeys collected during the Eastern Ghats Survey also provided material for the study of the Long-tailed Macaques (*M. radiata* and *sinica*) of South India and Ceylon. In a further paper on this subject, which also was published during the year, Mr. Pocock describes a new race from Travancore and gives the distinctive characters of the different species of Long-tailed Macaques from South India and Ceylon.

The late Mr. T. B. Fry contributed a paper on the proposed classifications of the Smaller Indian Field Mice. The author was able to study a very considerable range of specimens obtained by the Mammal Survey from different parts of India, Burma and Ceylon. His purpose was to complete Thomas' Review of Indian Field Mice published in Volume XXII of our Journal.

The late Mr. Fry was associated with the Society's Mammal Survey almost from its inception 20 years ago. On his retirement from the Indian Forest Service he spent his days in the British Museum classifying and arranging the enormous mass of material. Though his name was seldom associated with the scientific papers which appeared in connection with the Survey, yet as a patient collaborator and assistant to those great mammalogists, Thomas and Wroughton, who are now no more, his was a great contribution to the progress of Indian Mammalogy. His loss is felt deeply by the Society and the Mammal Department of the British Museum both of which he served so well and so faithfully.

Birds.—Messrs. Stanford and Ticehurst continued and completed their joint report on the 'Birds of Prome'. The paper was based on the material collected by the first-named author in the Prome district. Two papers were added to the long series of local lists of birds in the Oriental Region which have appeared in our Journal. One was a contribution by The Rev. F. S. Briggs on the 'Birds of Mhow' and the second on the 'Birds of the north-west corner of Fars, Persia', by C. E. Capito. Capt. F. N. Bates contributed a paper on the 'Bulbuls of the Nilgiri Hills'. Of considerable interest was Mr. Salim A. Ali's admirable paper on the 'Nesting Habits of the Bayas', in which he records the results of his careful and painstaking observations and brings to light interesting facts in connection with the nidification and sexual relationship of this common and well-known species.

Reptiles and Fishes.—Mr. J. J. Asana of the Gujarat College, Ahmedabad, contributed an interesting study of the life history of the 'Common Blood-Sucker' (*Calotes versicolor*). During the period under review we published two reports by Mr. D. D. Mukerji of the Zoological Survey of India on 'Collections of Fishes made by two of our Members, Col. R. W. Burton and Mr. R. C. Morris in the Bhawani River and in the streams of the Billigirirangan Hills'. In view of the forthcoming revision of Day's volumes on Fishes in the *Fauna of British India* series, members of the Society could help very materially in collecting fishes from local streams particularly in hill areas. The Society would gladly give all possible assistance in this connection.

Invertebrates.—Parts XXXVI, XXXVII and XXXVIII of 'Indian Dragonflies' by Major F. C. Fraser were published during the year. Other contributions on insects include a paper on the 'Butterflies of Coorg' by Mr. J. A. Yates which supplements Hannington's previous list of the butterflies of this province, published in Volume XXIV of the Journal. Many butterflies occurring in Coorg are equally common to Assam and Burma, and the presence of these allied races in areas so far apart is perhaps as difficult to account for as the isolation of Palearctic species in the Nilgiris and Palni Hill ranges. A paper on the 'Butterflies of the Simla Hills' was contributed by Mr. G. W. V. de Rhe Philippe. In his note on 'Indian Thysanoptera', Mr. T. V. Ramakrishna Ayyar, Madras Agricultural Department, supplements his Memoir on Indian Thysanoptera which appeared in the Memoirs of the Department of Agriculture, Vol. X, and describes 11 new species and one new genus. A paper on the 'Net-veined Midges (*Blepharoceridae*)' was contributed by Dr. S. L. Hora. The *Blepharoceridae* are of special interest to students of animal adaptations and evolution and the object of the author's note is to bring to the notice of collectors the general form and habits of these interesting flies. Other contributions on insects were 'Aspects of the Bionomics of the Lac Insects' and a paper on the 'Locust Cicada (*L. locusta*)' by C. McCann.

Botany.—Parts XIV, XV and XVI of the 'Revision of the Flora of the Bombay Presidency', by Rev. Fr. E. Blatter, S.J., were published during the year. The families dealt with were the *Sterculiaceae*, *Araceae* and *Orchidaceae*. The author in collaboration with Mr. McCann published a description of a new species of *Ceropegia* from the Western Ghats. Further notes on the 'Flowering of Bamboos', supplementing his previous papers on the subject, were also published by Father Blatter.

General.—We were privileged to publish during the year two papers on the "Problem of Evolution", by Lt.-Col. R. Seymour Sewell, Director of the Zoological Survey of India, being his presidential addresses before the Eighteenth Indian Science Congress and the annual meeting of the Royal Asiatic Society of Bengal. The author in the first part of his paper deals with experimental modifications in the bodily structure of animals and shows how in the higher forms of life, including man, a stage has been reached or is being rapidly reached in which further evolution becomes impossible. In the second part of his paper the author develops his theme and indicates the trend of evolution under natural conditions, as expressed in the tendency of the animal to cut off itself and its offspring from the influence of changes in its environment and from just those influences which were responsible for the origin and gradual development of new forms and higher races. The author postulates that man has, or in the near future will have, rendered himself so independent of his environment that this will no longer be able to affect his physical characters and that if there is to be any further evolution this must be the result of his own mental processes.

Economic.—Papers of economic interest published during the year were notes on 'Rats damaging the crops in Southern India' by P. N. Krishna Ayyar. The author indicates the principal species concerned and suggests measures for their control. Mr. Salim A. Ali contributed a paper on 'The Role of Sunbirds and Flower-Peckers' in the propagation of the tree parasite *Loranthus longiflorus*, a common parasite on Mango and other trees in Western India. The author's observations indicate that the life history of the parasite is so inextricably linked with the existence of these birds that the parasite would die out but for their intervention both as regards its propagation and distribution. Papers on the 'Fish Supply of the West Coast of India' were contributed by Sir Reginald Spence and S. H. Prater. The papers were in continuation of a previous article on the subject published by the authors in Volume XXIX of the Journal. The present articles deal with the economic aspect of the fisheries of the West Coast and indicate the principal species of economic importance, the deficiency of the supply and the means for its improvement. The authors also advocate the necessity for the establishment of a Department of Fisheries to investigate and to supply data essential to the commercial development of local Fisheries. Under existing conditions, an important source of food supply to a maritime population has been allowed to recede into comparative oblivion. We would also refer to Dr. H. C. Mueller's Note on 'Sea-Fishing on the Bombay Coast'. Dr. Mueller concludes from his observation of local fishing methods that the line of development should be the improvement of existing methods, not the introduction of methods foreign to the local fisherman. Fishing is now carried out mainly on the edge of the good fishing grounds within the 25-fathom line. The fleet must be in a position to go further and land their catches quicker. If they could continually fish from their boats and make use of all four tides, the result would be many times that of to-day's fishing. They could achieve all this if each village had a few boats fitted with motors, not so much for fishing as for the transport of fish. The fishing area is also circumscribed because of the prevailing method of anchoring boats to permanent stakes. The anchoring of boats in deeper water by means of an ordinary light anchor will be made possible for our fishermen if they have motor-driven winches at their disposal for lifting the anchors out of the soft mud.

Popular Articles.—Mr. Stuart Baker continued his serial on the 'Game Birds of the Indian Empire'. The present series deals with the Wading Birds. Three parts published during the year dealt with the Plovers and Lapwings. Possibly there is no country in the world in which the sportsman meets, as he does in India, such an extraordinary wealth of birds which come so near the border line of game birds, and the intention of the author is to help sportsmen to identify the hundred and one birds which he may, by chance or design, bring to bag in the course of a day's shooting. Two further instalment of Mr. Whistler's 'Study of Indian Birds' were published during the year. The present articles deal very interestingly with the phases of reproduction and nidification in birds. Eight parts of this serial have now been published and two further instalments will appear and when completed the papers will form a very helpful and instructive compendium to students of Indian Ornithology. Parts VI and VII of 'Beautiful Indian Trees' by the Rev. E. Blatter and Mr. W. S. Millard were issued during the period under review. The authors deal with the Cassias which

include perhaps the most ornamental and beautiful trees in this country. We should like also to refer to Lt.-Col. F. B. Scot's very interesting and beautifully illustrated paper on 'Indian Hawk-Moths'. The author's object is to rouse interest among our readers and to indicate the lines of study of these beautiful insects, of which about 180 different species occur in the Indian Empire. The paper concludes with notes on the breeding and collecting of Hawk-Moths. We concluded during the year Lt.-Col. A. H. E. Mosse's article on 'The Panther as I have known him'. Other articles of interest to Big Game Hunters were Mr. Morris' article on 'A Bag of Five Tigers' and Col. Burton's 'Burmese Jungle'. We are as anxious as any member to provide articles of popular interest in the Journal. But we have to depend on members themselves for contributions of this nature. There is an infinite variety of subjects of Natural History interest which can be interpreted in readable form. The Editors of the Journal would be only too pleased to consider contributions from readers of the Journal and assist whenever possible in their preparation.

We have again to thank the large number of members who contributed the Miscellaneous Notes published at the end of each number. They form a very readable feature of the Journal and offer an opportunity to every member to add to the interest and usefulness of its pages.

Publications.—The Society issued during the year 'Bird Life in India' by Capt. Bates. The book contains a series of chapters on Birds and Bird Nesting in various parts of India. It is beautifully illustrated with many charming camera studies by the author. The price to members is Rs. 6-12-0.

Forthcoming Publications.—The first Edition of Col. Evans' 'Identification of Indian Butterflies' having been rapidly sold out it was decided to issue a second edition: this edition embodies all the changes and corrections necessary and brings the nomenclature up to date and adds a great deal to what was known of the distribution. The book contains 32 black and white plates and will be ready for issue by the time this report is printed. Orders from members are being registered.

EXPEDITIONS AND EXPLORATIONS.

The study of the bird collections made during the Vernay Expedition to the Eastern Ghats very forcibly brought out the necessity for a survey of the Hyderabad State. Its geographical position in the centre of the Peninsula Region makes it a meeting ground of western and eastern races. Practically no material for the study of the birds of this area is available in any Museum collection. The prevailing financial stringency which has affected Governments, Societies, and individuals alike, made it very difficult to find funds to carry out a survey of this area. This Society is therefore greatly indebted to Mr. Salim A. Ali who offered to carry out this work mainly at his own expense. Work in the field was commenced in November and collections were made in various parts of the State. At the time of writing, Mr. Salim A. Ali is still in the field where he is being assisted by Mr. Henricks of our Bird Department. Our thanks and appreciation are due to Mr. Ali for his zeal and generosity in carrying out this useful work.

Early in 1931, Mr. Henricks was sent to help Mr. Stanford to carry out a survey of the birds of the Henzada District, Burma, on lines similar to his survey of the Prome Division. Mr. Henricks was in the field for two months when disturbed conditions in the Province compelled his return to India.

PRINCE OF WALES' MUSEUM.

Under existing conditions there is little hope that the Trustees of the Museum will be able to give effect to their original plan of building a New Natural History Wing of the Museum. Work in the Natural History Section was confined mainly to the improvement and development of the existing galleries. The most important addition to the galleries is a magnificent group illustrating a pair of tigers drinking at a forest stream. The scene of the group is laid in the forests of the Naga Hills in Assam, where the material was collected and studies for the backgrounds made during the recent expedition undertaken on behalf of the American Museum of Natural History, New York. The clumps of feathery bamboo, the moss-grown boulders of the stream, the background of forest and the soft lighting effects, make

a very realistic and effective setting for the tigers. The animals were presented to the Society by Lt.-Col. R. W. Burton and Mr. R. C. Morris. During the year the Mammal Gallery was overhauled and re-arranged. All the show cases were provided with painted backgrounds and the specimens arranged and exhibited to greater advantage. A small group of Gibbons was completed during the year.

Mr. F. V. Evans' generosity enabled us to continue the preparation of models of Marine Fishes of the West Coast. The models so far completed are exhibited in five cases in the Fish Gallery and include most of the important food fishes of Bombay. Mr. Evans has been one of the most generous benefactors of this Society and the Committee once again take the opportunity of recording their thanks and appreciation.

We wish also to express our thanks to those members of the Society who helped us in various fields of work. Our thanks are particularly due :—to Messrs. Whistler and Kinnear for their work in connection with Ornithological Reports of the Vernay Scientific Expedition which has made so great a contribution to the progress of Indian Ornithology,—to Mr. Pocock for his important papers on Indian mammals which have added to the standing and reputation of our journal,—and to Mr. Stuart Baker, Father Blatter and Mr. W. S. Millard who have helped so much to add to the interest of its pages.

STAFF.

The Committee take this opportunity of placing on record their appreciation of the work done by the Curator and his staff, both scientific and clerical.

EXPENDITURE AND RECEIPTS.

The total anticipated income of the Society for the year 1931 was Rs. 40,490-15-0. Actual receipts amounted to Rs. 40,312-4-6 as compared with Rs. 45,293-8-10 during 1930, showing a drop of Rs. 4,981-4-4. The drop in revenue is due to reduced receipts under the following heads:

	1930	1931
Life Membership	Rs. 3,500 0 0	Rs. 350 0 0
Annual Subscription	„ 26,781 13 3	„ 25,890 7 11
Sales of Journals	„ 4,208 5 11	„ 1,072 7 6

MEMBERSHIP.

On the 1st of January 1931 we had 1,112 members on our rolls. Of this number 1,047 paid their subscription. Approximately 5% did not pay. Economic depression, increased taxation and retrenchment have had an adverse effect on the activities of the Society and their influence is reflected in the large number of resignations and a serious drop in the recruitment of new members. In normal years there is an inevitable loss of membership through retirements and transfer, but this is usually more than balanced by the number of new members joining. In the last year 137 members resigned while the new members amounted to 47, showing an adverse balance of 90.

A special appeal was issued at the end of last year to members asking for their active co-operation in obtaining new members to make up for the loss that had been sustained. We appeal once again to members for their active help in this connection. The entrance fee has been reduced to Rs. 10 and the annual subscription may be paid now in two instalments.

RETRENCHMENT.

The loss in revenue has compelled us to economise in every way possible and we are now cutting down expenditure to the barest margin. Retrenchment has been effected in the salaries of the staff and in other avenues. It will be also necessary to introduce certain economies in the expenditure on the Journal by issuing fewer coloured plates and limiting the number of its pages. We have consistently endeavoured to maintain a high standard in the Journal and to make it as attractive as possible. We have, we trust, limited ourselves to such economies as will not in any way effect a reduction in this standard.

PROCEEDINGS AND ACCOUNTS

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PUBLICATIONS ACCOUNT.

Game Birds, Vols. I and II. The receipts during the year for sales of these volumes amounted to Rs. 2,240-9-9. The total expenditure from the commencement to date on these volumes was Rs. 65,520-10-8. The amount realised so far is Rs. 60,109-7-11; leaving a balance of Rs. 5,411-2-9 still to be recovered. Volume III of this series was published during 1931. The expenditure amounted to Rs. 7,407-15-11. The net amount realised so far is Rs. 5,481-2-7, leaving a balance of Rs. 1,926-13-4 to be realised.

Bird Charts.—These Charts, illustrating 210 Indian Birds in colour, were issued in 1931, at a total cost of Rs. 28,250—we have so far realised Rs. 17,571-5-4 on sales. A thousand sets were ordered from our printers. This number was based largely on orders previously received from schools and educational institutions. Unfortunately, retrenchment by Provincial Governments in the grants to schools has prevented many of them from taking up so far the charts which they had ordered from the Society.

These coloured illustrations of Indian Birds, made up in the form of charts, fill a long-felt need. In their present format they are perhaps inconvenient for individual use. It has been decided to issue a limited number of copies of these pictures bound in book form. Members who would like to acquire copies should register their orders with the Society.

22nd. March, 1932.

REGINALD SPENCE,
Joint Hon. Secretary.



BOMBAY NATURAL HISTORY SOCIETY.

BALANCE SHEET AS AT DECEMBER 31, 1931

LIABILITIES		ASSETS	
	Rs a p		Rs a p
Life Membership Fees	46,100 0 0	Investments at par or market value whichever is lower:	
Donations for specific objects unexpended:		Rs. 28,000 Govt. 3½% Notes at 51-13/16%	14,507 8 0
Show Cases, etc.	2,813 3 4	" 10,000 " 4% 1916/17 Loan at 84-4%	8,425 0 0
Building Fund	15,225 10 0	" 15,000 " 5% 1941-55 at Rs. 90	13,500 0 0
Field Museum for collecting expenses	7,000 0 0	" 8,000 Bom. Dev. Loan 1935 at 6½% at par	8,000 0 0
		" 14,000 Port Trust 4% Bonds at Rs. 57%	7,980 0 0
		" 15,000 Imp. " 4% " at Rs. 57½%	8,625 0 0
Sundry Creditors:		Investments on account of building fund:	
For publication of "Fish" Pamphlets		Rs. 10,000 Govt. 6% 1933-36 at Rs. 94	9,400 0 0
Butterfly Books	1,673 6 0	" 500 " 5% 1944-55 at Rs. 90	450 0 0
Printers of Journals	3,105 0 6	Fixed Deposits	5,255 10 0
" " Game Books, Vol. III	1,926 13 4	Cash—	
" " Bird Charts	5,062 9 0	With National Bank of India Ltd.,	2,456 4 7
For Expenses	230 0 0	With National Bank of India Ltd.,	324 0 11
Author's Profits	150 0 0	London £24-6-1 at 1/6	10,000 0 0
Surplus Assets—		On Fixed Deposit	150 0 0
Add: Balance from Publication	32,761 5 2	On hand	1,965 0 0
		Sundry Debtors	150 0 0
		Furniture: Less Depreciation	500 0 0
Less: Loss on Revenue Account	33,304 12 7	Publications, excluding Journals—	
Depreciation of Investments	11,897 8 8	As certified by the Secretary	2,137 2 5
		Note.—Any publications which have been on hand over 2 years have been written off.	9,122 3 4
		Game Books, Vol. III Stock on hand as certified by the Secretary	1,532 3 6
		Bird Charts, Stock on hand as certified by the Secretary	480 0 0
		Bates Bird Life, Stock on hand as certified by the Secretary	
		Beautiful Indian Trees: Stock on hand as certified by the Secretary	
		Game Books Vols. I & II at Cost	65,520 10 8
		Less: Realised to date	60,109 7 11
		Already written off in previous years	5,411 2 9
		Transferred to Revenue A/c	7,651 12 6
Total	1,06,323 0 9	Total	1,06,323 0 9

Note.—50% of any book profits to be paid to Authors. A stock of 18,000 old Journals and the valuable Research Collection and Library of 2,400 volumes have not been taken into account on the asset side of the Balance Sheet.

We have prepared the above Balance Sheet from the cash book and from information given to us, and have verified the investments and deposits.

In our opinion such Balance Sheet represents a true and correct view of the state of the Society's affairs according to the best of our information and

PROCEEDINGS AND ACCOUNTS

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BOMBAY NATURAL HISTORY SOCIETY.

REVENUE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER 1931.

	Rs	a	p	Rs	a	p	Rs	a	p
To Salaries ..	17,821	5	6	By Entrance Fee ..	..	..	950	0	0
.. Society's Contribution to Provident Fund ..	1,530	8	0	.. Subscriptions ..	..	..	25,890	7	11
.. General charges ..	1,103	11	11	.. Interest ..	..	..	4,611	0	10
.. Rent ..	2,436	0	0	.. Life Membership ..	..	..	350	0	0
.. Printing and Stationery ..	607	9	3	.. Sales of Journals less Expenses ..	..	..	1,022	7	6
.. Postage ..	1,227	8	3	.. Taxidermy Dept. ..	..	..	106	11	6
.. Library ..	385	11	5	.. Game Books, Vols. I and II. ..	..	..	2,240	9	9
.. Furniture depreciation ..	150	0	0	.. Loss ..	..	..	35,171	5	6
.. Fire Insurance ..	100	0	0	..	..	..	2,447	8	8
.. Audit Fee ..	250	0	0						
.. Cost of Journals ..	11,951	7	10						
Total ..	..	..	..			
				37,618	14	2			37,618 14 2
				37,618	14	2			37,618 14 2

PUBLICATION ACCOUNT FOR THE YEAR ENDED 31st DECEMBER 1931.

	Rs	a	p	Rs	a	p	Rs	a	p
To Author's Profit on Snake Book ..	150	0	0	By Sales—	..	..	169	0	0
.. Balance carried to Surplus Assets ..	543	7	5	.. Snake Charts ..	..	..	830	7	8
				.. Snake Books ..	..	..	193	15	9
				.. Society's Publications ..	..	..			693 7 5
Messrs. Vitty & Seaborne Ltd., London for Bird Charts.				.. Sales of Bird Charts during the year ..	..	..	11,860	5	4
Bates Bird Life in India ..				.. Stock on hand ..	..	..	9,122	3	4
									20,982 8 8
Game Books, Vol. III ..				.. Sale Proceeds from Bates' Bird Life in India ..	..	..	1,502	0	0
				.. Stock on hand ..	..	..	1,532	3	6
									3,034 3 6
				.. Sale Proceeds Game Book, Vol. III ..	..	..	2,366	3	6
				.. Stock on hand ..	..	..	2,137	2	5
									4,503 5 11

BOMBAY NATURAL HISTORY SOCIETY

INCOME AND EXPENDITURE
ACCOUNT OF DONATIONS FOR SPECIFIC PURPOSES FOR THE YEAR ENDED
31st DECEMBER 1931.

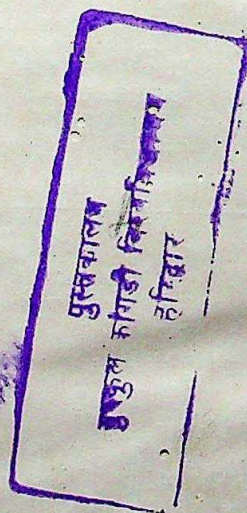
	Rs a p	Rs a p	Rs a p
To Expenditure on show cases, Modeller's salary etc.	2,690 5 3	3,803 8 7	
Depreciation of Building Fund Investments	650 0 0	15,615 0 0	
Balance carried to Balance Sheet	25,038 13 4	1,700 0 0	
	28,379 2 7	7,000 0 0	
		230 10 0	
		28,379 2 7	

BOMBAY, 25th February, 1932.

Examined and found correct.

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants, Auditors.

(Sd.) A. FORLINGTON,
Honorary Treasurer.



Compiled
1999-2000

यह पुस्तक वितरित न की जाय
NOT TO BE ISSUED

सन्दर्भ ग्रन्थ
REFERENCE BOOK

